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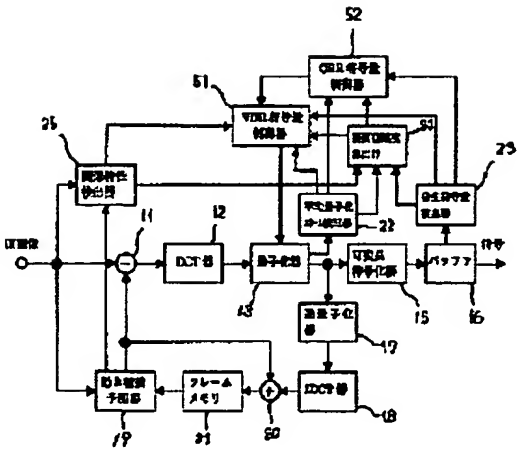
Abstract:
PROBLEM TO BE SOLVED: To provide a method by which a code amount is assigned more properly between picture types even when an object average bit rate is closer to a maximum transfer rate in a variable bit rate control method adopting a 1-path or 2-path method for a dynamic image coder.SOLUTION: The dynamic image coder encoding a dynamic image is provided with a means 23 that detects a code quantity generated from the dynamic image, a means 22 that detects a mean quantization scale of the dynamic image, a means 25 that detects a coding image characteristic of at least the dynamic image in the dynamic image and a motion compensation prediction image generated by a motion compensation prediction means, a 1st code quantity control means 51 that calculates a 1st assignment code quantity of the image to be coded next on the basis of the generated code quantity and the average quantization scale, a 2nd code quantity control means 52 that calculates a 2nd assigned code quantity placing a limit onto the 1st assigned code quantity and a means 51 that decides the quantization scale of the image to be coded next on the basis of the 1st and 2nd assigned code quantities.



JPO Machine translation abstract:

(57) **Abstract**

SUBJECT High efficiency coding of video is started, and when performing variable bit rate encoding especially, it is related with a suitable code quantity controller.

Means for SolutionA means 23 to detect a generated code amount of said video in video coding equipment which codes video, A means 22 to detect a normal child-ized scale of said video, and a means 25 to detect the coded image characteristic of said video at least among motion-compensation-prediction pictures generated by said video and said motion-compensation-prediction means, The 1st code-quantity-control means 51 that computes the 1st amount of allocation codes of a picture coded next from said generated code amount and a normal child-ized scale, It had a means 51 to determine the 2nd code-quantity-control means 52 that computes the 2nd amount of allocation codes that adds restriction to said 1st amount of allocation codes, and a quantizing scale of a picture coded from the said 1st and 2nd amounts of allocation codes to said next.

Claim(s)

Claim 1 Video coding equipment which codes an input moving image image by motion-compensation-prediction means, orthogonal transformation means, quantization means, and a variable-length-coding means, comprising:
A means to detect a generated code amount of each picture of said input moving image image.
A means to detect a normal child-ized scale of each picture of said input moving image image.
A means to detect the coded image characteristic of said input moving image image at least among motion-compensation-prediction pictures generated by said input moving image image and said motion-compensation-prediction means.
The 1st code-quantity-control means that computes the 1st amount of allocation codes of a picture coded next from a normal child-ized scale detected by generated code amount detected by a means to detect said generated code amount, and a means to detect said normal child-ized scale.
The 2nd code-quantity-control means that computes the 2nd amount of allocation codes for adding restriction to said 1st amount of allocation codes.
A means to determine a quantizing scale of a picture coded to said next from the amount of allocation codes computed by the said 1st and 2nd code-quantity-control means.

Claim 2 In video coding equipment indicated to Claim 1, said 2nd amount of allocation codes, a picture type (I picture, P picture, B picture) -- a maximum of the amount of allocation codes being computed independently, and, When determining the actual amount of allocation codes in said 1st code-quantity-control means, Video coding equipment determining the 2nd amount of allocation codes when said 1st computed amount of allocation codes exceeds a maximum of the amount of allocation codes set up in said 2nd amount of allocation codes, and determining said 1st amount of allocation codes as a actual amount of allocation codes when other.

Claim 3 Video coding equipment, wherein said 2nd code-quantity-control means is a code amount control method of a fixed bit rate in video coding equipment indicated to Claim 1 or Claim 2 and said 1st code-quantity-control means is a code amount control method of a Variable Bit Rate.

Claim 4 In video coding equipment indicated to either Claim 1 thru/or Claim 3, By a predetermined function which has a means to compute picture complexity from a picture characteristic parameter detected by a means to detect a generated code amount, a normal child-ized scale, and the coded image characteristic of each of said detected picture, and makes said picture complexity a factor. Video coding equipment changing said 2nd amount of allocation codes.
Claim 5 In video coding equipment indicated to either Claim 1 thru/or Claim 4, It has a stream division means which takes out a part of output-codes sequence coded by said variable-length-coding means, Video coding equipment, wherein said 1st code-quantity-control means controls a code amount of said whole output-codes sequence and controls some code amounts of said output-codes sequence taken out from said stream division means by said 2nd code-quantity-control means.
Claim 6A video encoding method which codes an input moving image image by motion-compensation-prediction step, orthogonal-transformation step, quantization step, and a variable-length-coding step, comprising:
A step which detects a generated code amount of each picture of said input moving image image.
A step which detects a normal child-ized scale of each picture of said input moving image image.
A step which detects the coded image characteristic of said input moving image image at least among motion-compensation-prediction pictures generated by said input moving image image and said motion-compensation-prediction step.
The 1st code-quantity-control step that computes the amount of allocation codes of a picture coded next from a normal child-ized scale detected by generated code amount detected by a step which detects said generated code amount, and a step which detects said quantizing scale.
The 2nd code-quantity-control step that computes the 2nd amount of allocation codes for adding restriction to said 1st amount of allocation codes.
A step which determines a quantizing scale of a picture coded to said next from the amount of allocation codes computed at the said 1st and 2nd code-quantity-control steps.

Claim 7 In a video encoding method indicated to Claim 6, said 2nd amount of allocation codes, a picture type (I picture, P picture, B picture) -- a maximum of the amount of allocation codes being computed independently, and, When determining the actual amount of allocation codes in said 1st code-quantity-control step, A video encoding method determining the 2nd amount of allocation codes when said 1st computed amount of allocation codes exceeds a maximum of the amount of allocation codes set up in said 2nd amount of allocation codes, and determining said 1st amount of allocation codes as a actual amount of allocation codes when other.
Claim 8 In a video encoding method indicated to Claim 6 or Claim 7, a generated code amount of each of said detected picture, A video encoding method characterized by changing said 2nd amount of allocation codes by a predetermined function which has a step which computes picture complexity from a normal child-ized scale and a picture characteristic parameter detected at a step which detects the coded image characteristic, and makes said picture complexity a factor.

Claim 9 In a video encoding method indicated to either Claim 6 thru/or Claim 8, It has a stream division step which takes out a part of output-codes sequence coded by said variable-length-coding step, A video encoding method, wherein said 1st code-quantity-control step controls a code amount of said whole output-codes sequence and controls some code amounts of said output-codes sequence taken out from said stream division means by said 2nd code-quantity-control step.

Detailed Description of the Invention
0001
Field of the Invention High efficiency coding of video is started, and when performing variable bit rate encoding especially, it is related with a suitable code quantity controller and a method for the same.
0002
Description of the Prior ArtMPEG 2 is already specified as international standards of the technology which codes video, such as a television signal, highly efficiently. MPEG 2 divides the "frame" picture which constitutes video into the 16x16-pixel block called a "macroblock", The movement quantity called a "motion vector" to each macro block unit in time in a front or the back between the predetermined image comparison and coded image which left several frames is calculated, "Motion-compensation-prediction" technology which constitutes a coded image from an image comparison based on this movement quantity, It is specified to the error signal or the coded image itself of motion compensation prediction based on the component engineering of two image coding of "conversion coding" technology which compresses the amount of information using DCT (discrete cosine transform) which is a kind of an orthogonal transformation.
0003 The example of 1 composition of the video coding equipment of the conventional MPEG 2 is shown in drawing 7, and an example of coding picture structure is shown in drawing 6. Motion compensation prediction is consisted of by combination of three kinds of pictures like coding picture structure which was shown in drawing 7, which are called I picture (formation of a frame inner code), P picture (forward direction prediction coding), and B picture (bidirectional prediction coding) and from which a prediction method differs. As shown in drawing 7, in conversion coding, DCT is given by DCT device 72 to the coded image itself to the output of the subtractor 71 which is an error signal of motion compensation prediction with the motion-compensation-prediction machine 77 in P and B picture at I picture.
0004 After quantization controls by the output of the code quantity controller 90 and is made with the quantizer 73 to the DCT coefficient obtained by this DCT device 72, Variable length coding is made with the variable-length-coding machine 75 with the attendant information of others, such as a motion vector, and it is outputted after a code sequence

is memorized by the buffer 76 as a "bit stream." Under the present circumstances, according to the sufficiency degree of the buffer 76, a quantizing scale is controlled by the code quantity controller 90. On the other hand, it supplies now decodes **local** and the power coefficient of the quantizer 73 is stored in the inverse quantization device 77 and the IDCT machine 78 by the frame memory 81 for every block.

0005 Since MPEG 2 is variable length coding, the generated code amount per unit time (bit rate) is not constant. Then, it is possible by changing suitably the quantizing scale in the case of quantization with the quantizer 73 into a macro block unit to control to the necessary bit rate. In MPEG 2 Test Model 5, the fixed bit rate control method which makes a generated code amount regularity by GOP units is proposed.

0006 In Test Model 5, code amount assignment which changes with picture types is performed. While assigning most many code amounts to I picture to which frame inner code-ization is performed, the quantizing scale of B picture with which a decoded image is not again used for prediction is increased 1.4 times of I and P picture, So that the code amount to B picture may be reduced, a decoded image may assign many the part to I and P picture which are used for prediction and the image quality of a decoded image may become fixed between picture types by lessening the code amount to assign further, Optimization of the code amount assignment by a picture type is attained.

0007 The fixed bit rate control method in this Test Model 5 is an effective method to the use as which a fixed transfer rate is required. However, since the almost same code amount is assigned to every portion of a video sequence, image quality deterioration will arise, without giving sufficient code amount to the complicated scene containing many amount of information. On the other hand, when the amount of information was few simple scenes, the code amount became a surplus and futility arose, and to the use in which a variable transfer rate is possible, it was not able to be said to be the suitable rate control method like DVD-Video.

0008 The rate control method which solves the above problems is the Variable Bit Rate control method. JP,H6-141298,A has disclosed the coding equipment by Variable Bit Rate control.In this equipment, first, to an input moving image image, temporary coding is performed and a generated code amount counts for every unit time with a fixed quantity child-ized scale. Next, based on the generated code amount at the time of temporary coding, the target transfer rate of each portion is set up so that the generated code amount of the whole input moving image image may become a necessary value. and -- receiving an input moving image image, controlling to agree in this target transfer rate -- the 2nd time -- it codes, and in other words, actual code-ization is performed.

0009 However, by the above-mentioned conventional example, in order to obtain an output bit stream, at least two coding must be performed, and for a use of which real time nature is required, Variable Bit Rate control of a two pass system like this equipment cannot be used.

0010 On the other hand, the Variable Bit Rate control method for coding video in real time mostly, i.e., the Variable Bit Rate control method of an one-pass system, exists. The coding equipment by the Variable Bit Rate control method of an one-pass system is indicated by JP,H10-164577,A at drawing 6 of said gazette, etc.

0011 The example of 1 composition of the video coding equipment in this conventional example is shown in drawing 8. Identical codes are attached to drawing 7 and an identical configuration part, and the explanation is omitted. The generated code amount in the equipment of this conventional example, supply the code amount memorized to the buffer 76 to the generated code amount detector 83, and according to this generated code amount detector 83, The quantizing scale from the quantizer 73 is supplied to the normal child-ized scale detector 82, It asks with the picture complexity calculation machine 84 by making a product with the average value of the quantizing scale in the screen by this normal child-ized scale detector 82 into "picture complexity", Based on the rate of the present picture complexity to the average value of the past picture complexity, the code-quantity-control machine 74 has realized Variable Bit Rate control by determining the target generated code quantity of a screen, or a targeted amount child-ized scale.

0012

Problem to be solved by the invention However, in Variable Bit Rate control, in many cases, restriction by a maximum transfer rate is received. When the target average bit rate is smaller enough than a maximum transfer rate, it is possible to make code amount assignment to B picture smaller than I and P picture like Test Model 5, and to optimize the code amount assignment between picture types.

0013 If the target average bit rate becomes close to a maximum transfer rate, the amount of allocation codes of I and P picture will come to receive restriction by a maximum transfer rate, the difference of the amount of allocation codes with B picture will contract, and, occasionally the amount of allocation codes will become almost the same between picture types. After the difference of the amount of allocation codes became small, compared with B picture, the image quality of I and P picture worsened relatively, and although the target average bit rate was high, there was a problem that image quality deterioration will be perceived by the difference of the image quality resulting from unsuitable code amount distribution.

0014 Then, in the Variable Bit Rate control method of the one pass in video coding equipment, and a two pass system, an object of this invention is to provide the method of realizing more suitable code amount assignment between picture types, when the target average bit rate is close to a maximum transfer rate.

0015

Means for solving problem In the video coding equipment provided with each means of motion compensation prediction, such as MPEG 2, an orthogonal transformation, quantization, and variable length coding in this invention, The 1st code-quantity-control means that determines the amount of allocation codes of the picture coded next from the generated code amount of each picture, a means to detect a normal child-ized scale and the obtained generated code amount, and a normal child-ized scale, It has the 2nd code-quantity-control means for adding restriction to the amount of allocation codes obtained by the 1st code-quantity-control means for every picture type. For example, when performing code amount assignment by Variable Bit Rate control, by the 1st code-quantity-control means, the amount of allocation codes by Variable Bit Rate control is calculated, and the maximum of the amount of allocation codes by fixed bit rate control of the highest transfer rate is searched for by the 2nd code-quantity-control means. Only when the

amount of allocation codes obtained by the 1st code-quantity-control means exceeds the maximum of the amount of allocation codes obtained by the 2nd code-quantity-control means, the code amount actually assigned to each picture, The maximum is made into the actual amount of allocation codes, and when other, let the amount of allocation codes obtained by the 1st code-quantity-control means be the actual amount of allocation codes. It becomes possible to hold the code amount assignment between picture types the optimal, without giving many code amounts unnecessary for B picture by this, when the target average bit rate is close to a maximum transfer rate.

0016 Picture complexity produced with the above-mentioned video coding equipment by performing predetermined operation to a generated code amount of each picture and a product of a normal child-ized scale is used, By setting up a predetermined function which makes picture complexity a factor, multiplying a maximum of the amount of allocation codes obtained by the 2nd aforementioned code-quantity-control means by this function, and changing a maximum of the amount of allocation codes, when performing Variable Bit Rate control of an one-pass system, Increase of a code amount in a portion near a maximum of the amount of allocation codes is controlled, and it becomes possible to ease image quality change at a point beyond a maximum of the amount of allocation codes.

0017a case where apply the above-mentioned video coding equipment and one encoded bit streams are shared by two decoding systems -- for example, the bit stream whole -- I, P, and all B pictures -- by ****** usual coding. When one decoding system decodes the whole bit stream and only I and P picture are decoded in another decoding system, Control a code amount of the whole bit stream by the 1st code-quantity-control means, and a code amount of bit stream portions of only I and P picture is controlled by the 2nd code-quantity-control means, It is possible by performing code amount assignment of the 1st code-quantity-control means to perform coding which can be decoded in two decoding systems with one coding equipment, restricting a code amount of I and P picture to the amount of allocation codes obtained by the 2nd code-quantity-control means.

0018

Mode for carrying out the invention The 1st embodiment of video coding equipment of this invention is described below with drawing 1. As shown in drawing 1, video coding equipment of this invention, and the 1st embodiment of the method, The subtractor 11, DCT device 12, the quantizer 13, the variable-length-coding machine 15, the buffer 16, the inverse quantization device 17, the IDCT machine 18, the motion-compensation-prediction machine 19, the adding machine 20, the frame memory 21, the normal child-ized scale detector 22, the generated code amount detector 23, the picture complexity calculation machine 24, It comprises the picture characteristic detector 25, the VBR code-quantity-control machine 51, and the CBR code-quantity-control machine 52.

0019A motivation picture shall be beforehand divided into a macro block unit by image block separator (not shown). Motion compensation prediction is not performed about I picture, but a divided motivation picture is quantized by a quantizing scale sent from the code-quantity-control machine 14 with the quantizer 13, after DCT of the motivation image block itself is sent and carried out to DCT device 12 which is a kind of a DC to AC converter via the subtractor 11.

0020 The quantized signal is changed into a mark with the variable-length-coding machine 15, and a mark is outputted after being adjusted by the following buffer 16. On the other hand, local decoding is carried out with the inverse quantization device 17 and the IDCT machine 18, and a power coefficient of the quantizer 13 is stored in the frame memory 21 for every block, without adding an output of the motion-compensation-prediction machine 19 with the adding machine 20.

0021 About P and B picture, a divided motivation image and a predetermined local decoded image block stored in the frame memory 21 are supplied to the motion-compensation-prediction machine 19, Motion vector detection and a motion compensation are performed here, and an error image block whose estimated image block difference between pixels is taken between original image blocks with the subtractor 11, and is a difference value is sent to DCT device 12.

0022A mark is outputted after DCT of the difference value was carried out by DCT device 12, it is changed into a mark with the variable-length-coding machine 15 like I picture after being quantized by a quantizing scale sent from the code-quantity-control machine 14 with the quantizer 13, and being adjusted by the following buffer 16 after this.

0023 Said estimated image block from the motion-compensation-prediction machine 19 is added for every pixel by the adding machine 20, and a power coefficient of the quantizer 13 is stored in the frame memory 21 for every block, after local decoding is carried out with the inverse quantization device 17 and the IDCT machine 18. About each picture, a quantizing scale for every macroblock is sent to the normal child-ized scale detector 22 from the quantizer 13, a quantizing scale for one frame is added there, and a normal child-ized scale of one frame is computed.

0024 On the other hand, in the buffer 16, a generated code amount is supervised and the value is sent to the generated code amount detector 23. In this generated code amount detector 23, a generated code amount is added per frame and a generated code amount of one frame is detected. A normal child-ized scale and a generated code amount which were detected about every frame are sent to the picture complexity calculation machine 24 and the CBR code-quantity-control machine 52, respectively.

0025 On the other hand, in the picture characteristic detector 25, a divided original image is inputted, a parameter which shows a picture characteristic to a macro block unit about each frame of an original image, i.e., an activity, is detected, it is added per frame, and the result is sent to the picture complexity calculation machine 24.

0026 Namely, since, as for the case of I picture, motion compensation prediction is not performed as for an input to the picture characteristic detector 25, Only a motivation picture divided into a macro block unit is inputted, an activity (ACTcur) which is a parameter which shows a picture characteristic to a macro block unit is detected, and it is added per frame, and is sent to the picture complexity calculation machine 24 as the activity ACTi of I picture.

0027 Although distribution of a luminance value, a difference value between pixels, etc. can be considered as an activity (ACTcur), other parameters may be used as long as a picture characteristic is shown.

0028 On the other hand, an input to the picture characteristic detector 25 shown in drawing 1, In the case of P and B picture, a motion vector used besides a divided motivation picture by error picture in motion compensation prediction of

a macro block unit or a difference image of a coded image and an image comparison in motion vector detection, and motion compensation prediction is inputted from the motion-compensation-prediction machine 19. The activity (original image) ACTcur is detected from a divided motivation picture by macro block unit as well as a case of I picture.
0029 On the other hand, in it, an absolute value sum or the square error sum is taken, and an error picture in motion compensation prediction of a macro block unit or a difference image of a coded image and an image comparison in motion vector detection is detected as the prediction activity ACTpred. Between contiguity macroblocks, an absolute value of difference is taken for every ingredient, and a direction of a motion vector used by motion compensation prediction is detected as ACTmv.
0030 And for every macroblock, by the operation of a following formula (1), ACTmb is computed, and it is added by one frame and sent to the picture complexity calculation machine 24 as the activities ACTp and ACTb of P and B picture.
0031
ACTmb=a-ACTcur+b-ACTpred+c-ACTmv (1)**0032**A picture exception changes the value of each constant a, b, and c according to prediction mode of a macroblock (are they intra, uni-directional prediction, or bidirectional prediction?) etc. For example, since it is thought that a generated code amount increases compared with the block which predicts by being set to b=c=0 since it does not predict like I picture in the case of Intra, the value of a is enlarged.
0033 Thus, presumption of the picture complexity based more on the coding characteristic is attained by performing activity detection adapted to prediction mode etc.
0034 With the picture complexity calculation machine 24, after the multiplication of the normal child-ized scale and generated code amount of each frame which were supplied is carried out, predetermined conversion is performed to a multiplication result, and it asks as picture complexity (past) of each frame. Average picture complexity Xi-ave of each picture type, Xp-ave, and Xb-ave are computed by division of the picture complexity being done with the frame number of the same picture type within the period, after the value within fixed time is added according to a coding picture type.

0035 The frame number beforehand defined in front in time within the fixed time said here from the picture which coding just ended, For example, there is also a case of fixed frame numbers, such as 15 frames and 300 frames, and a frame number may increase one by one like **to the picture which coding just ended from the encoding start frame** . When not fulfilling the fixed time which the coded frame number defined by the case of the former fixed frame number, either, the frame number will increase one by one like the latter.
0036 Picture complexity Xk-c (k= i, p, b) of the present picture to be coded from now on, The activity of the present picture can be presumed by the following formula (2) from ACTk (k= i, p, b), the same picture complexity Xk-p (k= i, p, b) of the picture of a picture type coded just before, and activity ACTk-p (k= i, p, b).
0037
Xk-c= Xk-p-ACTk/ACTk-p (2)**0038**When the frame which coding of the same picture type ended does not exist in an initial state, it asks for the picture complexity and the activity of the picture of each picture type by some pictures beforehand, What is necessary is to average it statistically according to the occurrence frequency of average video, and just to let it be an initial value.
0039 Average picture complexity Xi-ave of each picture type, Xp-ave, and Xb-ave, Presumed picture complexity Xi-c of the present picture to be coded from now on, Xp-c, and Xb-c are sent to the VBR code-quantity-control machine 51, and setting out of a quantizing scale for Variable Bit Rate control is performed here. If a frame number of 1GOP (usually interval of I picture) which is PictureRate and one encoding unit about BitRate and a frame number per second in the target average bit rate is set to N, the amount Rave of average allocation codes of 1GOP will be given with a following formula (3).
0040
Rave = -(BitRate/PictureRate) N (3)**0041**If Rave of an upper type considers it as the amount of required allocation codes of 1GOP at the time of average picture complexity, If a picture of 1GOP including the present picture to be coded from now on assumes that it is equal to presumed picture complexity of the present picture uniformly searched for with said picture complexity calculation machine 24, image quality will be given to the amount Rck (k= i, p, b) of required allocation codes of 1GOP uniformly required for a ****** case with a following formula (4).
0042
Rck= Rave-Xk-c/Xk-ave (4)**0043**By assigning Rck (k= i, p, b) of an upper type suitable for each picture of 1GOP, the target code quantity in the 1st code-quantity-control means of the present picture to be coded from now on is computed. Although the target-code-quantity allocation method of MPEG 2 Test Model 5 is listed to below as an example, methods other than this may be used.
0044 The setting-out ratio of the quantizing scale of P contained in 1GOP, P **as opposed to Np, Nb, and I picture for the frame number of B picture** , and B picture is set to Kp and Kb. At this time, the target assignment code amounts Ti, Tp, and Tb of each picture type are given with the following formula (5), (6), and (7). MAX **a and b** -- either a or b -- the operation which chooses the larger one is shown. Xi, Xp, and Xb are the picture complexity (product of the normal child-ized scale of the picture concerned, and a generated code amount) of the picture coded immediately before here.
0045
(I picture) Ti= MAX **A and B** A = Rc/(1+Np-Xp/(Xi-Kp) +Nb-Xb/(XI-Kb)) B = BitRate/(8 and PictureRate)
(5)**0046**
(P picture) Tp= MAX **C and D** C = Rc/(Np+Nb-Kp-Xb /(Kb-Xp)) D = BitRate/(8 and PictureRate)
(6)**0047**
(B picture) Tb= MAX **E and F** E = Rc/(Np+Np-Kb-Xp/(Kp-Kb)) F = BitRate/(8 and PictureRate)
(7)**0048**On the other hand with the CBR code-quantity-control machine 52, a normal child-ized scale of a frame unit, A generated code amount is inputted and the picture complexity Xi of a picture coded from both product just before, Xp, and Xb are calculated, Target assignment code amount Ti-max of each picture type in case BitRate is the highest

transfer rate (BitRateMax), Tp-max, and Tb-max are calculated like the target assignment code amounts Ti, Tp, and Tb in the 1st code-quantity-control means. Here, amount Rav-max of average allocation codes of 1GOP is common to each picture, and is given with a following formula (8).

0049

Rav-max= -(BitRateMax/PictureRate) N (8) Therefore,**0050**

(I picture) Ti-max= MAX **A and B** A =Rav-max /(1+Np-Xp/(Xi-Kp) +Nb-Xb/(Xi-Kb)) B = BitRateMax/(8 and PictureRate) (9)**0051**

(P picture) Tp-max = MAX **C and D** C =Rav-max /(Np+Nb-Kp-Xb /(Kb-Xp)) D = BitRateMax/(8 and PictureRate) (10)**0052**

(B picture) Tb-max = MAX **E and F** E = Rav-max/(Np+Np-Kb-Xp/(Kp-Kb)) F = BitRateMax/(8 and PictureRate) (11)**0053**Ti-max of an upper type, Tp-max, and Tb-max, Namely, it is a maximum of a target assignment code amount in the 2nd code-quantity-control means, These values are sent to the VBR code-quantity-control machine 51, about the picture type concerned of said picture of the present when it codes, a limiting circuit is applied with a value of Ti-max, Tp-max, and Tb-max, and a target assignment code amount of the present picture determines a value of said Ti, Tp, and Tb.

0054 Based on a target assignment code amount determined as mentioned above and a generated code amount of each macroblock detected with the buffer 16, a method of MPEG 2 Test Model 5 is used, and a quantizing scale of each macroblock is determined.

0055 From the picture characteristic detector 25, the activity ACTcur of each macroblock is sent also to the code-quantity-control machine 51, Although used for adaptive-quantization control which changes a quantizing scale of each macroblock based on an activity in MPEG 2 Test Model 5, it is not necessary to perform this adaptive-quantization control. A quantizing scale of each macroblock may be determined by a completely different method from this.

0056A quantizing scale of each macroblock outputted from the code-quantity-control machine 51 is sent to the quantizer 13, A mark is outputted, after variable length coding of the present picture (a divided original image after DCT or an error image block of motion compensation prediction) is quantized and carried out with this quantizing scale and it is adjusted with the buffer 16.

0057A generated code amount supervised with a quantizing scale for every macroblock and the buffer 16 is sent to the normal child-ized scale detector 22 and the generated code amount detector 23, and is used for code quantity control of the following picture, respectively.

0058 In the upper explanation, amount Rav-max of average allocation codes of 1GOP in the CBR code-quantity-control machine 52 was calculated as a code amount to which it is simply assigned by 1GOP at the time of the highest transfer rate (BitRateMax).On the other hand, if presumed picture complexity Xk-c of a predetermined function like drawing 2 (a) which makes a factor presumed picture complexity Xk-c (k= i, p, b) of the present picture to be coded from now on, for example, the present picture, increases, the value will set up the function f (Xk-c) which approaches 1 infinite.

0059 By using Rav-max' of a following formula (12) which carried out the multiplication of this function for every picture type instead of Rav-max, As shown in drawing 2 (b), press down gradually a generated code amount in a case of being close to the highest transfer rate of each picture type, and. Image quality deterioration of the picture type concerned produced from relation between picture complexity and the amount of allocation codes becoming discontinuous at a point beyond the highest transfer rate becomes possible **also pressing down a problem which becomes remarkable** .

0060

Rav-max' -- =f(Xk-c), (BitRateMax/PictureRate), andN -- a function (k=i, p, b) (12) which shows drawing 2 (a) f (Xk-c) here**0061**The 2nd embodiment of video coding equipment of this invention is described with drawing 3 below. In the 2nd embodiment, it is a case where this invention is applied to Variable Bit Rate code quantity control of a two pass system. A fundamental coding portion until it is changed into a mark with an original image input - the variable-length-coding machine 15 is the same as that of the 1st embodiment. Since encoding operation is performed twice (or more than it), temporary coding is performed first and the 2nd coding is performed based on a result of the generated code amount about one picture, it differs greatly that there is a portion which is different in both encoding operation.

0062 In the 1st coding, a quantizing scale sent to the quantizer 13 is not sent from the VBR code-quantity-control machine 51, but a fixed value (values, such as 6 and 8) is sent from the temporary coding quantization set scale machine 56 via switch SW1, and, thereby, quantization of a fixed value is performed. And a bit stream after variable length coding was performed in the variable-length-coding machine 15 is not sent to the buffer 16 for outputting it outside, but it is sent to the temporary coding generated code amount detector 53 via switch SW2, and a generated code amount of each picture in the 1st coding is detected.

0063A temporary transfer rate is computed by a generated code amount being sent to the temporary transfer rate memory 54 from the temporary coding generated code amount detector 53 one by one, and being added for every prescribed period. This operation is performed until coding of one image sequence is completed, and a temporary transfer rate for every prescribed period is accumulated in the temporary transfer rate memory 54.

0064 After the 1st coding is completed, a temporary generated code amount or an average temporary transfer rate of the whole image sequence is computed, this value and a temporary transfer rate for every prescribed period are sent to the target transfer rate calculation machine 55, and a target transfer rate for every **in the 2nd coding (actual-code-izing)** prescribed period is computed.

0065 The relation of the temporary transfer rate Rt for every prescribed period and target transfer rate R of the 2nd coding in the 1st coding sets up the predetermined function beforehand. For example, the following function as shown in (13) can be considered.

0066

$R=a-(Rt)$ (13) ^{b} (a and b are a constant, a> 0, and 0< b<1)**0067**The 1st temporary coding is completed, and if the

target transfer rate of the coding which is the 2nd time is determined, the 2nd coding (actual-code-izing) will be started according to the target transfer rate. In the 2nd coding, the value from which the quantizing scale sent to the quantizer 13 was obtained with the VBR code-quantity-control machine 51 is sent.

0068 The normal child-ized scale of each frame detected with the VBR code-quantity-control machine 51 here with the normal child-ized scale detector 22 and the generated code amount detector 23, and a generated code amount, From the target transfer rate for every prescribed period computed from the temporary encoded result with the target transfer rate calculation machine 55, the target assignment code amount of the picture to be coded from now on is calculated.

0069 On the other hand, it is inputted into the VBR code-quantity-control machine 51, a limiting circuit is applied to said target assignment code amount, and a target assignment code amount also determines the maximum of the target assignment (it can set for 2nd code-quantity-control means) code amount computed with the CBR code-quantity-control machine 52. The maximum of the target assignment code amount in the CBR code-quantity-control machine 52 is the same as that of (based on Rav-max) Ti-max in the 1st embodiment, Tp-max, and Tb-max.

0070 The quantizing scale of each macroblock is determined using the method of MPEG 2 Test Model 5 grade like the 1st embodiment based on the target assignment code amount determined as mentioned above and the generated code amount of each macroblock detected with the buffer 16.

0071 Thus, the quantizing scale of each determined macroblock is sent to the quantizer 13, and variable length coding of the picture (the divided original image after DCT or the error image block of motion compensation prediction) to be coded from now on is quantized and carried out with this quantizing scale.

0072A mark is outputted after being adjusted by the target transfer rate for every prescribed period which the bit stream generated here was supplied to the buffer 16 by the 2nd coding, and was computed with the target transfer rate calculation machine 55 here. The generated code amount supervised with the quantizing scale for every macroblock and the buffer 16 is sent to the normal child-ized scale detector 22 and the generated code amount detector 23, and is used for the code quantity control of the following picture, respectively.

0073 The 3rd embodiment of the video coding equipment of this invention is described with drawing 4 and drawing 5 below. Although the above embodiments **1st and 2nd** are the cases where this invention is applied to Variable Bit Rate code quantity control, this invention is not limited to it but broad application is possible for it. Like the video coding equipment shown in drawing 4, the encoded bit streams of the output of the buffer 16 are divided into two with the stream separator 59. The output of one of these outputs the whole encoded bit streams which use I like drawing 5, P, and all B pictures, and another side outputs the encoded bit streams which use only I and P picture before long.

0074 An output of only I and P picture shall be a header conversion machine which is not illustrated here, and a parameter of a header part, etc. shall be rewritten by suitable value. The code-quantity-control machine 1 (51A) of drawing 4 controls a code amount of the whole bit stream, and the code-quantity-control machine 2 (52A) controls a code amount of a bit stream of only I and P picture.

0075 Here, both average bit rate shall be set up so that the amount of average allocation codes of each picture type may serve as a comparatively near value with the code-quantity-control machine 1 (51A) and the code-quantity-control machine 2 (52A). In order to satisfy code quantity control of two bit streams simultaneously, a code amount quota result of I in the code-quantity-control machine 2 (52A) and P picture is sent to the code-quantity-control machine 1 (51A), With the code-quantity-control machine 1 (51A), to I and P picture, I as a result of the code-quantity-control machine 2 (52A) and code amount assignment of P picture are applied as it is, code amount assignment is newly performed about B picture, and control of the code-quantity-control machine 1 (51A) is realized.

0076 Thereby, by the whole bit stream, while control with the code-quantity-control machine 1 (51A) is performed, when I of a bit stream and P picture portion are taken out with the stream separator 59, a bit stream controlled by the code-quantity-control machine 2 (52A) can be obtained.

0077 When a bit stream of only I and P picture does not need to be outputted with the stream separator 59, in the code-quantity-control machine 1 (51A), the usual code amount assignment is performed about I, P, and B pictures of each, without performing code amount assignment with the code-quantity-control machine 2 (52A). When not performing code amount assignment with the code-quantity-control machine 2 (52A), a signal which shows it is sent to the stream separator 59, and an output is stopped for a bit stream of only I and P picture there.

0078 In a code-quantity-control form in which not only an embodiment of drawing 4 but this invention has two code-quantity-control machines, as opposed to the code-quantity-control machine 51A of a main direction -- ** -- by adding restriction by a code amount quota result for every picture type of the code-quantity-control machine 52A of a direction, Rationalization of code amount assignment of each picture type can be attained, or video coding equipment corresponding to two decoding systems can be realized to one encoded bit streams.

0079

Effect of the Invention The 1st code-quantity-control means that determines the amount of allocation codes of a coded image as mentioned above according to this invention, It has the 2nd code-quantity-control means that adds restriction to code amount assignment of the 1st code-quantity-control means, In Variable Bit Rate control, by the 1st code-quantity-control means For example, Variable Bit Rate control, By the 2nd code-quantity-control means, calculate the amount of allocation codes by fixed bit rate control of the highest transfer rate, and the actual amount of allocation codes, Only when the amount of allocation codes obtained by the 1st code-quantity-control means exceeds the amount of allocation codes obtained by the 2nd code-quantity-control means, the amount of allocation codes obtained by the 2nd code-quantity-control means is applied, and when other, the amount of allocation codes obtained by the 1st code-quantity-control means is applied. It becomes possible to hold the code amount assignment between picture types the optimal, without giving many code amounts unnecessary for B picture by this, when the target average bit rate is close to a maximum transfer rate.

0080 When control using the picture complexity produced by Variable Bit Rate control of an one-pass system by

performing predetermined operation to the generated code amount of each picture and the product of a normal child-ized scale is performed, By setting up the predetermined function which makes picture complexity a factor, multiplying the maximum of the amount of allocation codes obtained by the 2nd aforementioned code-quantity-control means by this function, and changing the maximum of the amount of allocation codes, Increase of the code amount in the portion near the maximum of the amount of allocation codes is controlled, and it becomes possible to ease image quality change at the point beyond the maximum of the amount of allocation codes.

0081 Also in the case where apply the above-mentioned video coding equipment and one encoded bit streams are shared by two decoding systems, By restricting code amount assignment of the 1st code-quantity-control means by code amount assignment obtained by the 2nd code-quantity-control means, it becomes possible to perform the coding which can be decoded in two decoding systems with one coding equipment.

Field of the Invention High efficiency coding of video is started, and when performing variable bit rate encoding especially, it is related with a suitable code quantity controller and a method for the same.

Description of the Prior ArtMPEG 2 is already specified as international standards of the technology which codes video, such as a television signal, highly efficiently. MPEG 2 divides the "frame" picture which constitutes video into the 16x16-pixel block called a "macroblock", The movement quantity called a "motion vector" to each macro block unit in time in a front or the back between the predetermined image comparison and coded image which left several frames is calculated, "Motion-compensation-prediction" technology which constitutes a coded image from an image comparison based on this movement quantity, It is specified to the error signal or the coded image itself of motion compensation prediction based on the component engineering of two image coding of "conversion coding" technology which compresses the amount of information using DCT (discrete cosine transform) which is a kind of an orthogonal transformation.

0003 The example of 1 composition of the video coding equipment of the conventional MPEG 2 is shown in drawing 7, and an example of coding picture structure is shown in drawing 6. Motion compensation prediction is consisted of by combination of three kinds of pictures like coding picture structure which was shown in drawing 7, which are called I picture (formation of a frame inner code), P picture (forward direction prediction coding), and B picture (bidirectional prediction coding) and from which a prediction method differs. As shown in drawing 7, in conversion coding, DCT is given by DCT device 72 to the coded image itself to the output of the subtractor 71 which is an error signal of motion compensation prediction with the motion-compensation-prediction machine 77 in P and B picture at I picture.

0004 After quantization controls by the output of the code quantity controller 90 and is made with the quantizer 73 to the DCT coefficient obtained by this DCT device 72, Variable length coding is made with the variable-length-coding machine 75 with the attendant information of others, such as a motion vector, and it is outputted after a code sequence is memorized by the buffer 76 as a "bit stream." Under the present circumstances, according to the sufficiency degree of the buffer 76, a quantizing scale is controlled by the code quantity controller 90. On the other hand, it supplies now decodes **local** and the power coefficient of the quantizer 73 is stored in the inverse quantization device 77 and the IDCT machine 78 by the frame memory 81 for every block.

0005 Since MPEG 2 is variable length coding, the generated code amount per unit time (bit rate) is not constant. Then, it is possible by changing suitably the quantizing scale in the case of quantization with the quantizer 73 into a macro block unit to control to the necessary bit rate. In MPEG 2 Test Model 5, the fixed bit rate control method which makes a generated code amount regularity by GOP units is proposed.

0006 In Test Model 5, code amount assignment which changes with picture types is performed. While assigning most many code amounts to I picture to which frame inner code-ization is performed, the quantizing scale of B picture with which a decoded image is not again used for prediction is increased 1.4 times of I and P picture, So that the code amount to B picture may be reduced, a decoded image may assign many the part to I and P picture which are used for prediction and the image quality of a decoded image may become fixed between picture types by lessening the code amount to assign further, Optimization of the code amount assignment by a picture type is attained.

0007 The fixed bit rate control method in this Test Model 5 is an effective method to the use as which a fixed transfer rate is required. However, since the almost same code amount is assigned to every portion of a video sequence, image quality deterioration will arise, without giving sufficient code amount to the complicated scene containing many amount of information. On the other hand, when the amount of information was few simple scenes, the code amount became a surplus and futility arose, and to the use in which a variable transfer rate is possible, it was not able to be said to be the suitable rate control method like DVD-Video.

0008 The rate control method which solves the above problems is the Variable Bit Rate control method. JP,H6-141298,A has disclosed the coding equipment by Variable Bit Rate control.In this equipment, first, to an input moving image image, temporary coding is performed and a generated code amount counts for every unit time with a fixed quantity child-ized scale. Next, based on the generated code amount at the time of temporary coding, the target transfer rate of each portion is set up so that the generated code amount of the whole input moving image image may become a necessary value. and -- receiving an input moving image image, controlling to agree in this target transfer rate -- the 2nd time -- it codes, and in other words, actual code-ization is performed.

0009 However, by the above-mentioned conventional example, in order to obtain an output bit stream, at least two coding must be performed, and for a use of which real time nature is required, Variable Bit Rate control of a two pass system like this equipment cannot be used.

0010 On the other hand, the Variable Bit Rate control method for coding video in real time mostly, i.e., the Variable Bit Rate control method of an one-pass system, exists. The coding equipment by the Variable Bit Rate control method of an one-pass system is indicated by JP,H10-164577,A at drawing 6 of said gazette, etc.
0011 The example of 1 composition of the video coding equipment in this conventional example is shown in drawing 8. Identical codes are attached to drawing 7 and an identical configuration part, and the explanation is omitted. The generated code amount in the equipment of this conventional example, supply the code amount memorized to the buffer 76 to the generated code amount detector 83, and according to this generated code amount detector 83, The quantizing scale from the quantizer 73 is supplied to the normal child-ized scale detector 82, It asks with the picture complexity calculation machine 84 by making a product with the average value of the quantizing scale in the screen by this normal child-ized scale detector 82 into "picture complexity", Based on the rate of the present picture complexity to the average value of the past picture complexity, the code-quantity-control machine 74 has realized Variable Bit Rate control by determining the target generated code quantity of a screen, or a targeted amount child-ized scale.

Effect of the Invention The 1st code-quantity-control means that determines the amount of allocation codes of a coded image as mentioned above according to this invention, It has the 2nd code-quantity-control means that adds restriction to code amount assignment of the 1st code-quantity-control means, In Variable Bit Rate control, by the 1st code-quantity-control means For example, Variable Bit Rate control, By the 2nd code-quantity-control means, calculate the amount of allocation codes by fixed bit rate control of the highest transfer rate, and the actual amount of allocation codes, Only when the amount of allocation codes obtained by the 1st code-quantity-control means exceeds the amount of allocation codes obtained by the 2nd code-quantity-control means, the amount of allocation codes obtained by the 2nd code-quantity-control means is applied, and when other, the amount of allocation codes obtained by the 1st code-quantity-control means is applied. It becomes possible to hold the code amount assignment between picture types the optimal, without giving many code amounts unnecessary for B picture by this, when the target average bit rate is close to a maximum transfer rate.
0080 When control using the picture complexity produced by Variable Bit Rate control of an one-pass system by performing predetermined operation to the generated code amount of each picture and the product of a normal child-ized scale is performed, By setting up the predetermined function which makes picture complexity a factor, multiplying the maximum of the amount of allocation codes obtained by the 2nd aforementioned code-quantity-control means by this function, and changing the maximum of the amount of allocation codes, Increase of the code amount in the portion near the maximum of the amount of allocation codes is controlled, and it becomes possible to ease image quality change at the point beyond the maximum of the amount of allocation codes.
0081 Also in the case where apply the above-mentioned video coding equipment and one encoded bit streams are shared by two decoding systems, By restricting code amount assignment of the 1st code-quantity-control means by code amount assignment obtained by the 2nd code-quantity-control means, it becomes possible to perform the coding which can be decoded in two decoding systems with one coding equipment.

Problem to be solved by the invention However, in Variable Bit Rate control, in many cases, restriction by a maximum transfer rate is received. When the target average bit rate is smaller enough than a maximum transfer rate, it is possible to make code amount assignment to B picture smaller than I and P picture like Test Model 5, and to optimize the code amount assignment between picture types.
0013 If the target average bit rate becomes close to a maximum transfer rate, the amount of allocation codes of I and P picture will come to receive restriction by a maximum transfer rate, the difference of the amount of allocation codes with B picture will contract, and, occasionally the amount of allocation codes will become almost the same between picture types. After the difference of the amount of allocation codes became small, compared with B picture, the image quality of I and P picture worsened relatively, and although the target average bit rate was high, there was a problem that image quality deterioration will be perceived by the difference of the image quality resulting from unsuitable code amount distribution.
0014 Then, in the Variable Bit Rate control method of the one pass in video coding equipment, and a two pass system, an object of this invention is to provide the method of realizing more suitable code amount assignment between picture types, when the target average bit rate is close to a maximum transfer rate.

Means for solving problem In the video coding equipment provided with each means of motion compensation prediction, such as MPEG 2, an orthogonal transformation, quantization, and variable length coding in this invention, The 1st code-quantity-control means that determines the amount of allocation codes of the picture coded next from the generated code amount of each picture, a means to detect a normal child-ized scale and the obtained generated code amount, and a normal child-ized scale, It has the 2nd code-quantity-control means for adding restriction to the amount of allocation codes obtained by the 1st code-quantity-control means for every picture type. For example, when performing code amount assignment by Variable Bit Rate control, by the 1st code-quantity-control means, the amount of allocation codes by Variable Bit Rate control is calculated, and the maximum of the amount of allocation codes by fixed bit rate control of the highest transfer rate is searched for by the 2nd code-quantity-control means. Only when the amount of allocation codes obtained by the 1st code-quantity-control means exceeds the maximum of the amount of

allocation codes obtained by the 2nd code-quantity-control means, the code amount actually assigned to each picture, The maximum is made into the actual amount of allocation codes, and when other, let the amount of allocation codes obtained by the 1st code-quantity-control means be the actual amount of allocation codes. It becomes possible to hold the code amount assignment between picture types the optimal, without giving many code amounts unnecessary for B picture by this, when the target average bit rate is close to a maximum transfer rate.

0016 Picture complexity produced with the above-mentioned video coding equipment by performing predetermined operation to a generated code amount of each picture and a product of a normal child-ized scale is used, By setting up a predetermined function which makes picture complexity a factor, multiplying a maximum of the amount of allocation codes obtained by the 2nd aforementioned code-quantity-control means by this function, and changing a maximum of the amount of allocation codes, when performing Variable Bit Rate control of an one-pass system, Increase of a code amount in a portion near a maximum of the amount of allocation codes is controlled, and it becomes possible to ease image quality change at a point beyond a maximum of the amount of allocation codes.

0017a case where apply the above-mentioned video coding equipment and one encoded bit streams are shared by two decoding systems -- for example, the bit stream whole -- I, P, and all B pictures -- by ****** usual coding. When one decoding system decodes the whole bit stream and only I and P picture are decoded in another decoding system, Control a code amount of the whole bit stream by the 1st code-quantity-control means, and a code amount of bit stream portions of only I and P picture is controlled by the 2nd code-quantity-control means, It is possible by performing code amount assignment of the 1st code-quantity-control means to perform coding which can be decoded in two decoding systems with one coding equipment, restricting a code amount of I and P picture to the amount of allocation codes obtained by the 2nd code-quantity-control means.

0018

Mode for carrying out the invention The 1st embodiment of video coding equipment of this invention is described below with drawing 1. As shown in drawing 1, video coding equipment of this invention, and the 1st embodiment of the method, The subtractor 11, DCT device 12, the quantizer 13, the variable-length-coding machine 15, the buffer 16, the inverse quantization device 17, the IDCT machine 18, the motion-compensation-prediction machine 19, the adding machine 20, the frame memory 21, the normal child-ized scale detector 22, the generated code amount detector 23, the picture complexity calculation machine 24, It comprises the picture characteristic detector 25, the VBR code-quantity-control machine 51, and the CBR code-quantity-control machine 52.

0019A motivation picture shall be beforehand divided into a macro block unit by image block separator (not shown). Motion compensation prediction is not performed about I picture, but a divided motivation picture is quantized by a quantizing scale sent from the code-quantity-control machine 14 with the quantizer 13, after DCT of the motivation image block itself is sent and carried out to DCT device 12 which is a kind of a DC to AC converter via the subtractor 11.

0020 The quantized signal is changed into a mark with the variable-length-coding machine 15, and a mark is outputted after being adjusted by the following buffer 16. On the other hand, local decoding is carried out with the inverse quantization device 17 and the IDCT machine 18, and a power coefficient of the quantizer 13 is stored in the frame memory 21 for every block, without adding an output of the motion-compensation-prediction machine 19 with the adding machine 20.

0021 About P and B picture, a divided motivation image and a predetermined local decoded image block stored in the frame memory 21 are supplied to the motion-compensation-prediction machine 19, Motion vector detection and a motion compensation are performed here, and an error image block whose estimated image block difference between pixels is taken between original image blocks with the subtractor 11, and is a difference value is sent to DCT device 12.

0022A mark is outputted after DCT of the difference value was carried out by DCT device 12, it is changed into a mark with the variable-length-coding machine 15 like I picture after being quantized by a quantizing scale sent from the code-quantity-control machine 14 with the quantizer 13, and being adjusted by the following buffer 16 after this.

0023 Said estimated image block from the motion-compensation-prediction machine 19 is added for every pixel by the adding machine 20, and a power coefficient of the quantizer 13 is stored in the frame memory 21 for every block, after local decoding is carried out with the inverse quantization device 17 and the IDCT machine 18. About each picture, a quantizing scale for every macroblock is sent to the normal child-ized scale detector 22 from the quantizer 13, a quantizing scale for one frame is added there, and a normal child-ized scale of one frame is computed.

0024 On the other hand, in the buffer 16, a generated code amount is supervised and the value is sent to the generated code amount detector 23. In this generated code amount detector 23, a generated code amount is added per frame and a generated code amount of one frame is detected. A normal child-ized scale and a generated code amount which were detected about every frame are sent to the picture complexity calculation machine 24 and the CBR code-quantity-control machine 52, respectively.

0025 On the other hand, in the picture characteristic detector 25, a divided original image is inputted, a parameter which shows a picture characteristic to a macro block unit about each frame of an original image, i.e., an activity, is detected, it is added per frame, and the result is sent to the picture complexity calculation machine 24.

0026 Namely, since, as for the case of I picture, motion compensation prediction is not performed as for an input to the picture characteristic detector 25, Only a motivation picture divided into a macro block unit is inputted, an activity (ACTcur) which is a parameter which shows a picture characteristic to a macro block unit is detected, and it is added per frame, and is sent to the picture complexity calculation machine 24 as the activity ACTi of I picture.

0027 Although distribution of a luminance value, a difference value between pixels, etc. can be considered as an activity (ACTcur), other parameters may be used as long as a picture characteristic is shown.

0028 On the other hand, the input to the picture characteristic detector 25 shown in drawing 1, In the case of P and B picture, the motion vector used besides the divided motivation picture by the error picture in the motion compensation prediction of a macro block unit or the difference image of the coded image and image comparison in motion vector

detection, and motion compensation prediction is inputted from the motion-compensation-prediction machine 19. The activity (original image) ACTcur is detected from the divided motivation picture by the macro block unit as well as the case of I picture.

0029 On the other hand, in it, an absolute value sum or the square error sum is taken, and the error picture in the motion compensation prediction of a macro block unit or the difference image of the coded image and image comparison in motion vector detection is detected as the prediction activity ACTpred. Between contiguity macroblocks, the absolute value of difference is taken for every ingredient, and the direction of the motion vector used by motion compensation prediction is detected as ACTmv.

0030 And for every macroblock, by the operation of a following formula (1), ACTmb is computed, and it is added by one frame and sent to the picture complexity calculation machine 24 as the activities ACTp and ACTb of P and B picture.

0031

ACTmb=a-ACTcur+b-ACTpred+c-ACTmv (1)**0032**A picture exception changes a value of each constant a, b, and c according to prediction mode of a macroblock (are they intra, uni-directional prediction, or bidirectional prediction?) etc. For example, since it is thought that a generated code amount increases compared with a block which predicts by being set to b=c=0 since it does not predict like I picture in the case of Intra, a value of a is enlarged.

0033 Thus, presumption of picture complexity based more on a coding characteristic is attained by performing activity detection adapted to prediction mode etc.

0034 With the picture complexity calculation machine 24, after the multiplication of a normal child-ized scale and a generated code amount of each frame which were supplied is carried out, predetermined conversion is performed to a multiplication result, and it asks as picture complexity (past) of each frame. Average picture complexity Xi-ave of each picture type, Xp-ave, and Xb-ave are computed by division of the picture complexity being done with a frame number of the same picture type within the period, after a value within fixed time is added according to a coding picture type.

0035 The frame number beforehand defined in front in time within the fixed time said here from the picture which coding just ended, For example, there is also a case of fixed frame numbers, such as 15 frames and 300 frames, and a frame number may increase one by one like **to the picture which coding just ended from the encoding start frame** . When not fulfilling the fixed time which the coded frame number defined by the case of the former fixed frame number, either, the frame number will increase one by one like the latter.

0036 Picture complexity Xk-c (k= i, p, b) of the present picture to be coded from now on, The activity of the present picture can be presumed by the following formula (2) from ACTk (k= i, p, b), the same picture complexity Xk-p (k= i, p, b) of the picture of a picture type coded just before, and activity ACTk-p (k= i, p, b).

0037

Xk-c= Xk-p-ACTk/ACTk-p (2)**0038**When the frame which coding of the same picture type ended does not exist in an initial state, it asks for the picture complexity and the activity of the picture of each picture type by some pictures beforehand, What is necessary is to average it statistically according to the occurrence frequency of average video, and just to let it be an initial value.

0039 Average picture complexity Xi-ave of each picture type, Xp-ave, and Xb-ave, Presumed picture complexity Xi-c of the present picture to be coded from now on, Xp-c, and Xb-c are sent to the VBR code-quantity-control machine 51, and setting out of the quantizing scale for Variable Bit Rate control is performed here. If the frame number of 1GOP (usually interval of I picture) which is PictureRate and one encoding unit about BitRate and the frame number per second in the target average bit rate is set to N, the amount Rave of average allocation codes of 1GOP will be given with a following formula (3).

0040

Rave = -(BitRate/PictureRate) N (3)**0041**If Rave of an upper type considers it as the amount of required allocation codes of 1GOP at the time of average picture complexity, If the picture of 1GOP including the present picture to be coded from now on assumes that it is equal to the presumed picture complexity of the present picture uniformly searched for with said picture complexity calculation machine 24, image quality will be given to the amount Rck (k= i, p, b) of required allocation codes of 1GOP uniformly required for a ****** case with a following formula (4).

0042

Rck= Rave-Xk-c/Xk-ave (4)**0043**By assigning Rck (k= i, p, b) of an upper type suitable for each picture of 1GOP, target code quantity in the 1st code-quantity-control means of the present picture to be coded from now on is computed. Although a target-code-quantity allocation method of MPEG 2 Test Model 5 is listed to below as an example, methods other than this may be used.

0044A setting-out ratio of a quantizing scale of P contained in 1GOP, P **as opposed to Np, Nb, and I picture for a frame number of B picture** , and B picture is set to Kp and Kb. At this time, the target assignment code amounts Ti, Tp, and Tb of each picture type are given with the following formula (5), (6), and (7). MAX **a and b** -- either a or b -- operation which chooses the larger one is shown. Xi, Xp, and Xb are the picture complexity (product of a normal child-ized scale of the picture concerned, and a generated code amount) of a picture coded immediately before here.

0045

(I picture) Ti= MAX **A and B** A = Rc/(1+Np-Xp/(Xi-Kp) +Nb-Xb/(Xi-Kb)) B = BitRate/(8 and PictureRate)

(5)**0046**

(P picture) Tp= MAX **C and D** C = Rc/(Np+Nb-Kp-Xb /(Kb-Xp)) D = BitRate/(8 and PictureRate)

(6)**0047**

(B picture) Tb= MAX **E and F** E = Rc/(Np+Np-Kb-Xp/(Kp-Kb)) F = BitRate/(8 and PictureRate)

(7)**0048**On the other hand with the CBR code-quantity-control machine 52, a normal child-ized scale of a frame unit, A generated code amount is inputted and the picture complexity Xi of a picture coded from both product just before, Xp, and Xb are calculated, Target assignment code amount Ti-max of each picture type in case BitRate is the highest transfer rate (BitRateMax), Tp-max, and Tb-max are calculated like the target assignment code amounts Ti, Tp, and Tb

in the 1st code-quantity-control means. Here, amount Rav-max of average allocation codes of 1GOP is common to each picture, and is given with a following formula (8).

0049

Rav-max= -(BitRateMax/PictureRate) N (8) Therefore,**0050**

(I picture) Ti-max= MAX **A and B** A =Rav-max /(1+Np-Xp/(Xi-Kp) +Nb-Xb/(Xi-Kb)) B = BitRateMax/(8 and PictureRate) (9)**0051**

(P picture) Tp-max = MAX **C and D** C =Rav-max /(Np+Nb-Kp-Xb /(Kb-Xp)) D = BitRateMax/(8 and PictureRate) (10)**0052**

(B picture) Tb-max = MAX **E and F** E = Rav-max/(Np+Np-Kb-Xp/(Kp-Kb)) F = BitRateMax/(8 and PictureRate) (11)**0053**Ti-max of an upper type, Tp-max, and Tb-max, Namely, it is a maximum of a target assignment code amount in the 2nd code-quantity-control means, These values are sent to the VBR code-quantity-control machine 51, about the picture type concerned of said picture of the present when it codes, a limiting circuit is applied with a value of Ti-max, Tp-max, and Tb-max, and a target assignment code amount of the present picture determines a value of said Ti, Tp, and Tb.

0054 Based on a target assignment code amount determined as mentioned above and a generated code amount of each macroblock detected with the buffer 16, a method of MPEG 2 Test Model 5 is used, and a quantizing scale of each macroblock is determined.

0055 From the picture characteristic detector 25, the activity ACTcur of each macroblock is sent also to the code-quantity-control machine 51, Although used for adaptive-quantization control which changes a quantizing scale of each macroblock based on an activity in MPEG 2 Test Model 5, it is not necessary to perform this adaptive-quantization control. A quantizing scale of each macroblock may be determined by a completely different method from this.

0056A quantizing scale of each macroblock outputted from the code-quantity-control machine 51 is sent to the quantizer 13, A mark is outputted, after variable length coding of the present picture (a divided original image after DCT or an error image block of motion compensation prediction) is quantized and carried out with this quantizing scale and it is adjusted with the buffer 16.

0057A generated code amount supervised with a quantizing scale for every macroblock and the buffer 16 is sent to the normal child-ized scale detector 22 and the generated code amount detector 23, and is used for code quantity control of the following picture, respectively.

0058 In the upper explanation, amount Rav-max of average allocation codes of 1GOP in the CBR code-quantity-control machine 52 was calculated as a code amount to which it is simply assigned by 1GOP at the time of the highest transfer rate (BitRateMax).On the other hand, if presumed picture complexity Xk-c of a predetermined function like drawing 2 (a) which makes a factor presumed picture complexity Xk-c (k= i, p, b) of the present picture to be coded from now on, for example, the present picture, increases, the value will set up the function f (Xk-c) which approaches 1 infinite.

0059 By using Rav-max' of the following formula (12) which carried out the multiplication of this function for every picture type instead of Rav-max, As shown in drawing 2 (b), press down gradually the generated code amount in the case of being close to the highest transfer rate of each picture type, and. The image quality deterioration of the picture type concerned produced from the relation between picture complexity and the amount of allocation codes becoming discontinuous at the point beyond the highest transfer rate becomes possible **also pressing down the problem which becomes remarkable** .

0060

Rav-max' -- =f(Xk-c), (BitRateMax/PictureRate), andN -- the function (k=i, p, b) (12) which shows drawing 2 (a) f (Xk-c) here**0061**The 2nd embodiment of the video coding equipment of this invention is described with drawing 3 below. In the 2nd embodiment, it is a case where this invention is applied to the Variable Bit Rate code quantity control of a two pass system. The fundamental coding portion until it is changed into a mark with an original image input - the variable-length-coding machine 15 is the same as that of the 1st embodiment. Since encoding operation is performed twice (or more than it), temporary coding is performed first and the 2nd coding is performed based on the result of the generated code amount about one picture, it differs greatly that there is a portion which is different in both encoding operation.

0062 In the 1st coding, a quantizing scale sent to the quantizer 13 is not sent from the VBR code-quantity-control machine 51, but a fixed value (values, such as 6 and 8) is sent from the temporary coding quantization set scale machine 56 via switch SW1, and, thereby, quantization of a fixed value is performed. And a bit stream after variable length coding was performed in the variable-length-coding machine 15 is not sent to the buffer 16 for outputting it outside, but it is sent to the temporary coding generated code amount detector 53 via switch SW2, and a generated code amount of each picture in the 1st coding is detected.

0063A temporary transfer rate is computed by a generated code amount being sent to the temporary transfer rate memory 54 from the temporary coding generated code amount detector 53 one by one, and being added for every prescribed period. This operation is performed until coding of one image sequence is completed, and a temporary transfer rate for every prescribed period is accumulated in the temporary transfer rate memory 54.

0064 After the 1st coding is completed, a temporary generated code amount or an average temporary transfer rate of the whole image sequence is computed, this value and a temporary transfer rate for every prescribed period are sent to the target transfer rate calculation machine 55, and a target transfer rate for every **in the 2nd coding (actual-code-izing)** prescribed period is computed.

0065A relation of the temporary transfer rate Rt for every prescribed period and target transfer rate R of the 2nd coding in the 1st coding sets up a predetermined function beforehand. For example, the following function as shown in (13) can be considered.

0066

R=a- (Rt) (13) ^{b} (a and b are a constant, a> 0, and 0< b<1)**0067**The 1st temporary coding is completed, and if a

target transfer rate of coding which is the 2nd time is determined, the 2nd coding (actual-code-izing) will be started according to the target transfer rate. In the 2nd coding, a value from which a quantizing scale sent to the quantizer 13 was obtained with the VBR code-quantity-control machine 51 is sent.

0068A normal child-ized scale of each frame detected with the VBR code-quantity-control machine 51 here with the normal child-ized scale detector 22 and the generated code amount detector 23, and a generated code amount, From a target transfer rate for every prescribed period computed from a temporary encoded result with the target transfer rate calculation machine 55, a target assignment code amount of a picture to be coded from now on is calculated.

0069 On the other hand, it is inputted into the VBR code-quantity-control machine 51, a limiting circuit is applied to said target assignment code amount, and a target assignment code amount also determines a maximum of a target assignment (it can set for 2nd code-quantity-control means) code amount computed with the CBR code-quantity-control machine 52. A maximum of a target assignment code amount in the CBR code-quantity-control machine 52 is the same as that of (based on Rav-max) Ti-max in the 1st embodiment, Tp-max, and Tb-max.

0070A quantizing scale of each macroblock is determined using a method of MPEG 2 Test Model 5 grade like the 1st embodiment based on a target assignment code amount determined as mentioned above and a generated code amount of each macroblock detected with the buffer 16.

0071 Thus, a quantizing scale of each determined macroblock is sent to the quantizer 13, and variable length coding of the picture (a divided original image after DCT or an error image block of motion compensation prediction) to be coded from now on is quantized and carried out with this quantizing scale.

0072A mark is outputted after being adjusted by target transfer rate for every prescribed period which a bit stream generated here was supplied to the buffer 16 by the 2nd coding, and was computed with the target transfer rate calculation machine 55 here. A generated code amount supervised with a quantizing scale for every macroblock and the buffer 16 is sent to the normal child-ized scale detector 22 and the generated code amount detector 23, and is used for code quantity control of the following picture, respectively.

0073 The 3rd embodiment of video coding equipment of this invention is described with drawing 4 and drawing 5 below. Although the above embodiments **1st and 2nd** are the cases where this invention is applied to Variable Bit Rate code quantity control, this invention is not limited to it but broad application is possible for it. Like video coding equipment shown in drawing 4, encoded bit streams of an output of the buffer 16 are divided into two with the stream separator 59. Output of one of these outputs the whole encoded bit streams which use I like drawing 5, P, and all B pictures, and another side outputs encoded bit streams which use only I and P picture before long.

0074 The output of only I and P picture shall be a header conversion machine which is not illustrated here, and the parameter of a header part, etc. shall be rewritten by the suitable value. The code-quantity-control machine 1 (51A) of drawing 4 controls the code amount of the whole bit stream, and the code-quantity-control machine 2 (52A) controls the code amount of the bit stream of only I and P picture.

0075 Here, both average bit rate shall be set up so that the amount of average allocation codes of each picture type may serve as a comparatively near value with the code-quantity-control machine 1 (51A) and the code-quantity-control machine 2 (52A). In order to satisfy the code quantity control of two bit streams simultaneously, the code amount quota result of I in the code-quantity-control machine 2 (52A) and P picture is sent to the code-quantity-control machine 1 (51A), With the code-quantity-control machine 1 (51A), to I and P picture, I as a result of the code-quantity-control machine 2 (52A) and code amount assignment of P picture are applied as it is, code amount assignment is newly performed about B picture, and control of the code-quantity-control machine 1 (51A) is realized.

0076 Thereby, by the whole bit stream, while control with the code-quantity-control machine 1 (51A) is performed, when I of a bit stream and P picture portion are taken out with the stream separator 59, the bit stream controlled by the code-quantity-control machine 2 (52A) can be obtained.

0077 When the bit stream of only I and P picture does not need to be outputted with the stream separator 59, in the code-quantity-control machine 1 (51A), the usual code amount assignment is performed about I, P, and B pictures of each, without performing code amount assignment with the code-quantity-control machine 2 (52A). When not performing code amount assignment with the code-quantity-control machine 2 (52A), the signal which shows it is sent to the stream separator 59, and an output is stopped for the bit stream of only I and P picture there.

0078 In the code-quantity-control form in which not only the embodiment of drawing 4 but this invention has two code-quantity-control machines, as opposed to the code-quantity-control machine 51A of a main direction -- ** -- by adding restriction by the code amount quota result for every picture type of the code-quantity-control machine 52A of a direction, Rationalization of code amount assignment of each picture type can be attained, or the video coding equipment corresponding to two decoding systems can be realized to one encoded bit streams.

Brief Description of the Drawings

Drawing 1 It is a block block diagram showing the video coding equipment of this invention, and the 1st embodiment of the method.

Drawing 2 It is a figure showing the relation between the function in the case of Rav-max' calculation of the 1st embodiment of this invention, and Xk-c and the amount of allocation codes.

Drawing 3 It is a block block diagram showing the video coding equipment of this invention, and the 2nd embodiment of the method.

Drawing 4 It is a block block diagram showing the video coding equipment of this invention, and the 3rd embodiment of the method.

Drawing 5 It is a figure showing the situation of the bit stream division by the stream division means of the 3rd embodiment of this invention.

Drawing 6 It is a figure showing an example of coding picture structure.
Drawing 7 It is a figure showing the example of 1 composition of common video coding equipment.
Drawing 8 It is a figure showing the example of 1 composition of conventional video coding equipment.
Explanations of letters or numerals
11 Subtractor
12 DCT device (DC to AC converter)
13 Quantizer
14 Code-quantity-control machine
15 Variable-length-coding machine
16 Buffer
17 Inverse quantization device
18 IDCT machine
19 Motion-compensation-prediction machine
20 Adding machine
21 Frame memory
22 Normal child-ized scale detector
23 Generated code amount detector
24 Picture complexity calculation machine
25 Picture characteristic detector
51 VBR code-quantity-control machine
52 CBR code-quantity-control machine
51A Code-quantity-control machine 1
52A Code-quantity-control machine 2
53 Temporary coding generated code amount detector
54 Temporary transfer rate memory
55 Target transfer rate calculation machine
56 Temporary coding quantization set scale machine
59 Stream separator
The amount of average allocation codes of 1GOP in case Rav-max BitRate is the highest transfer rate (BitRateMax)
The amount of required allocation codes of Rck 1GOP (k= i, p, b)
SW1 and SW2 Switch
The target assignment code amount of Tk each picture type (k= i, p, b)
The target assignment code amount of each picture type in case Tk-max BitRate is the highest transfer rate (BitRateMax) (k= i, p, b)
Picture complexity of the picture of Xk present (k= i, p, b)
Presumed picture complexity of a picture of the Xk-c present (k= i, p, b)

Drawing 1

For drawings please refer to the original document.

Drawing 6

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

Drawing 4

For drawings please refer to the original document.

Drawing 7

For drawings please refer to the original document.

Drawing 8

For drawings please refer to the original document.

For drawings please refer to the original document.

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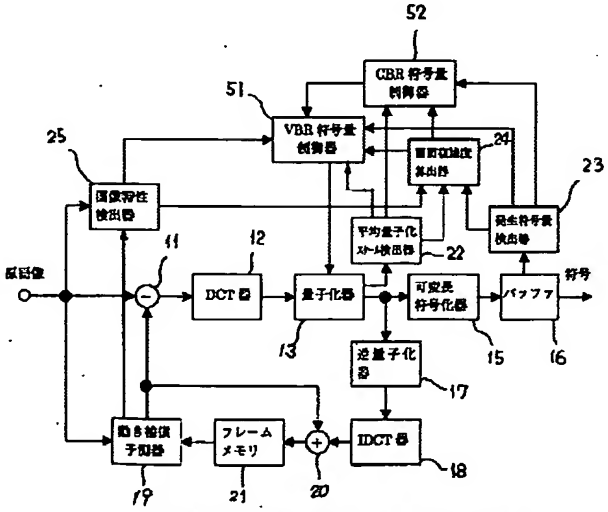
最終頁に続く

(54)【発明の名称】　動画像符号化装置及びその方法

(57)【要約】
【課題】　動画像の高能率符号化に係り、特に、可変ビットレート符号化を行う際に好適な符号量制御装置に関する。
【解決手段】　動画像の符号化を行う動画像符号化装置において、前記動画像の発生符号量を検出する手段２３と、前記動画像の平均量子化スケールを検出する手段２２と、前記動画像及び前記動き補償予測手段によって生成される動き補償予測画像のうち少なくとも前記動画像の符号化画像特性を検出する手段２５と、前記発生符号量、平均量子化スケールから、次に符号化する画像の第１の割当符号量を算出する第１の符号量制御手段５１と、前記第１の割当符号量に制限を加える第２の割当符号量を算出する第２の符号量制御手段５２と、前記第１及び第２の割当符号量から前記次に符号化する画像の量子化スケールを決定する手段５１とを備えた。



本発明の第１の実施の形態における動画像符号化装置

【特許請求の範囲】
【請求項１】入力動画像を、動き補償予測手段、直交変換手段、量子化手段、及び可変長符号化手段によって符号化を行う動画像符号化装置において、
前記入力動画像の各画像の発生符号量を検出する手段と、
前記入力動画像の各画像の平均量子化スケールを検出する手段と、
前記入力動画像及び前記動き補償予測手段によって生成される動き補償予測画像のうち少なくとも前記入力動画像の符号化画像特性を検出する手段と、
前記発生符号量を検出する手段によって検出された発生符号量、前記平均量子化スケールを検出する手段によって検出された平均量子化スケールから、次に符号化する画像の第１の割当符号量を算出する第１の符号量制御手段と、
前記第１の割当符号量に制限を加えるための第２の割当符号量を算出する第２の符号量制御手段と、
前記第１及び第２の符号量制御手段で算出した割当符号量から、前記次に符号化する画像の量子化スケールを決定する手段とを備えたことを特徴とする動画像符号化装置。
【請求項２】請求項１に記載された動画像符号化装置において、
前記第２の割当符号量は、ピクチャタイプ(Ｉピクチャ、Ｐピクチャ、Ｂピクチャ)別に割当符号量の上限が算出され、前記第１の符号量制御手段において実際の割当符号量を決定する際に、
算出された前記第１の割当符号量が、前記第２の割当符号量で設定された割当符号量の上限を超えた場合は第２の割当符号量を、それ以外の場合は前記第１の割当符号量を実際の割当符号量として決定することを特徴とする動画像符号化装置。
【請求項３】請求項１または請求項２に記載された動画像符号化装置において、
前記第２の符号量制御手段は固定ビットレートの符号量制御方法であり、
前記第１の符号量制御手段は可変ビットレートの符号量制御方法であることを特徴とする動画像符号化装置。
【請求項４】請求項１乃至請求項３のいずれかに記載された動画像符号化装置において、
前記検出された各画像の発生符号量、平均量子化スケール、及び符号化画像特性を検出する手段で検出される画像特性パラメータから画面複雑度を算出する手段を有し、
前記画面複雑度を因数とする所定の関数によって、前記第２の割当符号量を変更することを特徴とする動画像符号化装置。
【請求項５】請求項１乃至請求項４のいずれかに記載された動画像符号化装置において、
前記可変長符号化手段によって符号化された出力符号列の一部を取り出すストリーム分割手段を有し、
前記第１の符号量制御手段は前記出力符号列全体の符号量を制御し、
前記第２の符号量制御手段では前記ストリーム分割手段から取り出した前記出力符号列の一部の符号量を制御することを特徴とする動画像符号化装置。
【請求項６】入力動画像を、動き補償予測ステップ、直交変換ステップ、量子化ステップ、及び可変長符号化ステップによって符号化を行う動画像符号化方法において、
前記入力動画像の各画像の発生符号量を検出するステップと、
前記入力動画像の各画像の平均量子化スケールを検出するステップと、
前記入力動画像及び前記動き補償予測ステップによって生成される動き補償予測画像のうち少なくとも前記入力動画像の符号化画像特性を検出するステップと、
前記発生符号量を検出するステップによって検出された発生符号量、前記量子化スケールを検出するステップによって検出された平均量子化スケールから、次に符号化する画像の割当符号量を算出する第１の符号量制御ステップと、
前記第１の割当符号量に制限を加えるための第２の割当符号量を算出する第２の符号量制御ステップと、
前記第１及び第２の符号量制御ステップで算出した割当符号量から、前記次に符号化する画像の量子化スケールを決定するステップとを備えたことを特徴とする動画像符号化方法。
【請求項７】請求項６に記載された動画像符号化方法において、
前記第２の割当符号量は、ピクチャタイプ(Ｉピクチャ、Ｐピクチャ、Ｂピクチャ)別に割当符号量の上限が算出され、前記第１の符号量制御ステップにおいて実際の割当符号量を決定する際に、
算出された前記第１の割当符号量が、前記第２の割当符号量で設定された割当符号量の上限を超えた場合は第２の割当符号量を、それ以外の場合は前記第１の割当符号量を実際の割当符号量として決定することを特徴とする動画像符号化方法。
【請求項８】請求項６または請求項７に記載された動画像符号化方法において、
前記検出された各画像の発生符号量、平均量子化スケール、及び符号化画像特性を検出するステップで検出される画像特性パラメータから画面複雑度を算出するステップを有し、
前記画面複雑度を因数とする所定の関数によって、前記第２の割当符号量を変更することを特徴とする動画像符号化方法。
【請求項９】請求項６乃至請求項８のいずれかに記載さ

れた動画像符号化方法において、
前記可変長符号化ステップによって符号化された出力符号列の一部を取り出すストリーム分割ステップを有し、
前記第１の符号量制御ステップは前記出力符号列全体の符号量を制御し、
前記第２の符号量制御ステップでは前記ストリーム分割手段から取り出した前記出力符号列の一部の符号量を制御することを特徴とする動画像符号化方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】動画像の高能率符号化に係り、特に、可変ビットレート符号化を行う際に好適な符号量制御装置及びその方法に関する。
【０００２】
【従来の技術】ＴＶ信号などの動画像を高能率に符号化する技術の国際標準として既にMPEG2が規定されている。MPEG2は、動画像を構成する「フレーム」画像を「マクロブロック」と呼ばれる16×16画素のブロックに分割し、各マクロブロック単位に、時間的に前または後に所定の数フレーム離れた参照画像と符号化画像の間で「動きベクトル」と呼ばれる動き量を求め、この動き量を基に参照画像から符号化画像を構成する「動き補償予測」技術と、動き補償予測の誤差信号または符号化画像そのものに対して、直交変換の一種であるＤＣＴ(離散コサイン変換)を用いて情報量を圧縮する「変換符号化」技術の2つの画像符号化の要素技術をベースに規定されている。
【０００３】従来のMPEG2の動画像符号化装置の一構成例を図７に、また、符号化ピクチャ構造の一例を図６に示す。動き補償予測では、図７に示した符号化ピクチャ構造のように、Ｉピクチャ(フレーム内符号化)、Ｐピクチャ(順方向予測符号化)、Ｂピクチャ(双方向予測符号化)と呼ばれる、予測方法の異なる３種類のピクチャの組合せによって構成される。図７に示されるように、変換符号化では、Ｉピクチャでは符号化画像そのものに対し、Ｐ,Ｂピクチャでは動き補償予測器７７による動き補償予測の誤差信号である減算器７１の出力に対して、ＤＣＴがＤＣＴ器７２で施される。
【０００４】このＤＣＴ器７２で得られたＤＣＴ係数に対して量子化が、符号量制御部９０の出力により制御して量子化器７３によってなされた後に、動きベクトル等のその他の付帯情報と共に可変長符号化が可変長符号化器７５でなされ、符号列が「ビットストリーム」としてバッファ７６に記憶された後に出力される。この際、バッファ７６の充足度に応じて符号量制御部９０で量子化スケールが制御される。一方、量子化器７３の出力係数は、逆量子化器７７、ＩＤＣＴ器７８に供給さて、局部復号されてブロック毎にフレームメモリ８１に貯えられる。
【０００５】MPEG2は可変長符号化であるため、単位時間当りの発生符号量(ビットレート)は一定ではない。そこで、量子化器７３での量子化の際の量子化スケールをマクロブロック単位に適宜変更することにより、所要のビットレートに制御することが可能になっている。MPEG 2 Test Model 5では、GOP単位で発生符号量を一定にする固定ビットレート制御方法が提案されている。
【０００６】Test Model 5ではピクチャタイプによって異なる符号量割当が行われる。フレーム内符号化が行われるＩピクチャに対しては最も多くの符号量を割り当てる一方、復号画像が再度予測に使われることのないＢピクチャの量子化スケールをI及びＰピクチャの1.4倍にして、割り当てる符号量を一層少なくすることによって、Ｂピクチャに対する符号量を削減し、その分を復号画像が予測に使われるＩ及びＰピクチャに多く割り当てて、復号画像の画質がピクチャタイプ間で一定になるように、ピクチャタイプによる符号量割当の最適化を図っている。
【０００７】このTest Model 5における固定ビットレート制御方法は、一定の転送レートが要求される用途に対しては有効な方法である。しかし、動画像シーケンスのどの部分に対してもほぼ同じ符号量が割り当てられるため、情報量を多く含む複雑なシーンに対しては十分な符号量が与えられずに画質劣化が生じてしまう。これに対して、情報量が少ない単純なシーンの場合には符号量が余剰になって無駄が生じ、DVD-Videoのように可変転送レートが可能な用途に対しては、適切なレート制御方法とは言えなかった。
【０００８】以上のような問題を解決するレート制御方法が可変ビットレート制御方法である。特開平6－１４１２９８号公報には、可変ビットレート制御による符号化装置が開示されている。この装置では、最初に、入力動画像に対して固定量子化スケールによって仮符号化を行い、単位時間毎に発生符号量がカウントされる。つぎに、入力動画像全体の発生符号量が所要値になるように、仮符号化時の発生符号量に基づいて各部分の目標転送レートを設定する。そしてこの目標転送レートに合致するように制御を行いながら、入力動画像に対して２回目の符号化、言い換えると実符号化が行われる。
【０００９】しかし、上記従来例では、出力ビットストリームを得るためには少なくとも２回の符号化を行わなければならず、リアルタイム性を要求されるような用途ではこの装置のような２パス方式の可変ビットレート制御は使用出来ない。
【００１０】これに対し、動画像をほぼリアルタイムで符号化するための可変ビットレート制御方法、すなわち１パス方式の可変ビットレート制御方法も存在する。特開平１０－１６４５７７号公報には、１パス方式の可変ビットレート制御方法による符号化装置が前記公報の図６等に開示されている。
【００１１】この従来例における動画像符号化装置の一

構成例を図８に示す。なお、図７と同一構成部に対しては同一符号を付してその説明は省略する。この従来例の装置では、バッファ７６に記憶した符号量を発生符号量検出器８３に供給し、この発生符号量検出器８３による発生符号量と、量子化器７３からの量子化スケールを平均量子化スケール検出器８２に供給し、この平均量子化スケール検出器８２による画面内の量子化スケールの平均値との積を「画面複雑度」として画面複雑度算出器８４で求め、過去の画面複雑度の平均値に対する現在の画面複雑度の割合を基に、画面の目標発生符号量または目標量子化スケールを決定することにより、可変ビットレート制御を符号量制御器７４で実現している。

【００１２】

【発明が解決しようとする課題】しかしながら可変ビットレート制御の場合、多くの場合は最大転送レートによる制限を受ける。目標平均ビットレートが最大転送レートより充分に小さい場合は、Test Model 5のようにＢピクチャに対する符号量割当をＩ及びＰピクチャよりも小さくして、ピクチャタイプ間の符号量割当を最適化することが可能である。

【００１３】目標平均ビットレートが最大転送レートに近くなると、Ｉ及びＰピクチャの割当符号量が最大転送レートによる制限を受けるようになり、Ｂピクチャとの割当符号量の差が縮小し、時には割当符号量がピクチャタイプ間でほとんど同じになってしまう。割当符号量の差が小さくなってしまうと、Ｂピクチャに比べ、Ｉ及びＰピクチャの画質が相対的に悪くなり、目標平均ビットレートが高いにもかかわらず、不適切な符号量配分に起因する画質の差によって画質劣化が知覚されてしまうといった問題があった。

【００１４】そこで本発明は、動画像符号化装置における１パス及び２パス方式の可変ビットレート制御方法において、目標平均ビットレートが最大転送レートに近い場合においても、ピクチャタイプ間でより適切な符号量割当を実現する方法を提供することを目的とする。

【００１５】

【課題を解決するための手段】本発明では、MPEG２等の動き補償予測、直交変換、量子化、及び可変長符号化の各手段を備えた動画像符号化装置において、各画像の発生符号量と平均量子化スケールを検出する手段、得られた発生符号量と平均量子化スケールから次に符号化する画像の割当符号量を決定する第１の符号量制御手段と、ピクチャタイプ毎に第１の符号量制御手段で得られる割当符号量に制限を加えるための第２の符号量制御手段を有することを特徴とする。例えば、可変ビットレート制御による符号量割当を行う場合、第１の符号量制御手段では可変ビットレート制御による割当符号量を求め、第２の符号量制御手段では最高転送レートの固定ビットレート制御による割当符号量の上限を求める。実際に各画像に割当てる符号量は、第１の符号量制御手段で得られた割当符号量が第２の符号量制御手段で得られる割当符号量の上限を上回った場合のみ、その上限を実際の割当符号量とし、それ以外の場合は第１の符号量制御手段で得られた割当符号量を実際の割当符号量とする。これによって、目標平均ビットレートが最大転送レートに近い場合においても、Ｂピクチャに不必要に多くの符号量を与えることもなく、ピクチャタイプ間の符号量割当を最適に保持することが可能になる。

【００１６】また、上記の動画像符号化装置で、各画像の発生符号量と平均量子化スケールの積に所定の操作を施して得られる画面複雑度を用いて、１パス方式の可変ビットレート制御を行う場合、画面複雑度を因数とする所定の関数を設定し、この関数を前記の第２の符号量制御手段で得られる割当符号量の上限に乗じて割当符号量の上限を変更することにより、割当符号量の上限に近い部分における符号量の増大を抑制すると共に、割当符号量の上限を超えた点での画質変動を緩和することが可能になる。

【００１７】また、上記の動画像符号化装置を応用して、１つの符号化ビットストリームを２つの復号系で共用する場合、例えばビットストリーム全体ではＩ，Ｐ，Ｂピクチャ全て使った通常の符号化で、１つの復号系はビットストリーム全体を復号し、もう１つの復号系ではＩとＰピクチャのみを復号する時、第１の符号量制御手段ではビットストリーム全体の符号量を制御し、第２の符号量制御手段ではＩとＰピクチャのみのビットストリーム部分の符号量を制御して、Ｉ，Ｐピクチャの符号量を第２の符号量制御手段で得られる割当符号量に制限しながら、第１の符号量制御手段の符号量割当を行うことにより、１つの符号化装置で２つの復号系において復号可能な符号化を行うことが可能である。

【００１８】

【発明の実施の形態】本発明の動画像符号化装置の第1の実施例について、図１と共に以下に説明する。図１に示したように、本発明の動画像符号化装置及びその方法の第1の実施例は、減算器１１、ＤＣＴ器１２、量子化器１３、可変長符号化器１５、バッファ１６、逆量子化器１７、ＩＤＣＴ器１８、動き補償予測器１９、加算器２０、フレームメモリ２１、平均量子化スケール検出器２２、発生符号量検出器２３、画面複雑度算出器２４、画像特性検出器２５、ＶＢＲ符号量制御器５１、及びＣＢＲ符号量制御器５２より構成されている。

【００１９】原動画像は画像ブロック分割器（図示せず）によって、予めマクロブロック単位に分割されているものとする。分割された原動画像は、Ｉピクチャについては動き補償予測が行われず、原動画像ブロックそのものが減算器１１を介して直交変換器の一種であるＤＣＴ器１２に送られ、ＤＣＴされた後に量子化器１３で符号量制御器１４から送られる量子化スケールによって量子化される

【００２０】その量子化された信号は、可変長符号化器１５で符号に変換されて、つぎのバッファ１６で調整された後に符号が出力される。一方、量子化器１３の出力係数は、逆量子化器１７、ＩＤＣＴ器１８で局部復号されて、動き補償予測器１９の出力が加算器２０で加算されることなく、ブロック毎にフレームメモリ２１に貯えられる。

【００２１】Ｐ及びＢピクチャについては、分割された原動画像とフレームメモリ２１に貯えられた所定の局部復号画像ブロックが動き補償予測器１９に供給され、ここで動きベクトル検出及び動き補償が行われて、予測画像ブロックが減算器１１で原画像ブロックとの間で画素間差分が取られ、差分値である誤差画像ブロックがＤＣＴ器１２に送られる。

【００２２】この後はＩピクチャと同様にして、ＤＣＴ器１２で差分値がＤＣＴされ、量子化器１３で符号量制御器１４から送られる量子化スケールによって量子化された後に、可変長符号化器１５で符号に変換されて、つぎのバッファ１６で調整された後に符号が出力される。

【００２３】量子化器１３の出力係数は、逆量子化器１７とＩＤＣＴ器１８とで局部復号された後に、動き補償予測器１９からの前記予測画像ブロックが加算器２０によって画素毎に加算され、ブロック毎にフレームメモリ２１に貯えられる。また、各ピクチャについて、量子化器１３からマクロブロック毎の量子化スケールが平均量子化スケール検出器２２に送られ、そこで1フレーム分の量子化スケールが加算され、1フレームの平均量子化スケールが算出される。

【００２４】一方、バッファ１６においては、発生符号量が監視され、その値が発生符号量検出器２３に送られる。この発生符号量検出器２３において、発生符号量がフレーム単位に加算され、1フレームの発生符号量が検出される。フレーム毎について検出された平均量子化スケール、発生符号量は画面複雑度算出器２４とＣＢＲ符号量制御器５２に夫々送られる。

【００２５】一方、画像特性検出器２５では、分割された原画像が入力され、原画像の各フレームについてマクロブロック単位に画像特性を示すパラメータ、すなわちアクティビティが検出され、フレーム単位に加算されてその結果が画面複雑度算出器２４に送られる。

【００２６】すなわち、画像特性検出器２５への入力は、Ｉピクチャの場合は動き補償予測が行われないため、マクロブロック単位に分割された原動画像のみが入力され、マクロブロック単位に画像特性を示すパラメータであるアクティビティ(ACTcur)が検出され、フレーム単位に加算され、Ｉピクチャのアクティビティ ACTiとして画面複雑度算出器２４に送られる。

【００２７】アクティビティ(ACTcur)としては輝度値の分散、画素間差分値などが考えられるが、画像特性を示すものであればその他のパラメータでも良い。

【００２８】一方、図１に示す画像特性検出器２５への入力は、Ｐ及びＢピクチャの場合は、分割された原動画像の他に、マクロブロック単位の動き補償予測における誤差画像または動きベクトル検出における符号化画像と参照画像との差分画像と、動き補償予測で使用した動きベクトルが動き補償予測器１９から入力される。分割された原動画像からはIピクチャの場合と同様にマクロブロック単位に(原画像)アクティビティ ACTcurが検出される。

【００２９】一方、マクロブロック単位の動き補償予測における誤差画像または動きベクトル検出における符号化画像と参照画像との差分画像は、その中で絶対値和または２乗誤差和がとられ、予測アクティビティ ACTpredとして検出される。さらに、動き補償予測で使用した動きベクトルの方は、隣接マクロブロックとの間で各成分毎に差分の絶対値がとられ、ACTmvとして検出される。

【００３０】そして、各マクロブロック毎に次式(1)の演算により、ACTmbが算出され、それが１フレーム分加算されて、Ｐ及びＢピクチャのアクティビティ ACTp及びACTbとして画面複雑度算出器２４に送られる。

【００３１】

$$ACTmb = a \cdot ACTcur + b \cdot ACTpred + c \cdot ACTmv \quad (1)$$

【００３２】なお、各定数ａ、ｂ、ｃの値はピクチャ別、マクロブロックの予測モード別(イントラか片方向予測か双方向予測か)などで変化させる。例えば、イントラの場合はＩピクチャと同様に予測を行わないので、ｂ＝ｃ＝０となり、予測を行うブロックに比べて発生符号量が多くなると考えられるので、ａの値を大きくする。

【００３３】このように、予測モード等に即したアクティビティ検出を行うことにより、より符号化特性に即した画面複雑度の推定が可能になる。

【００３４】画面複雑度算出器２４では供給された各フレームの平均量子化スケールと発生符号量が乗算された後に乗算結果に所定の変換が施されて、各フレームの(過去の)画面複雑度として求められる。画面複雑度は符号化ピクチャタイプ別に一定期間内の値が加算された後にその期間内の同じピクチャタイプのフレーム数で除算されて、各ピクチャタイプの平均画面複雑度 Xi-ave, Xp-ave, Xb-ave が算出される。

【００３５】ここで言う一定期間内は、符号化の終了したばかりの画像から時間的に前に予め定めるフレーム数、例えば１５フレームとか、３００フレームといった一定のフレーム数の場合もあり、符号化開始フレームから符号化の終了したばかりの画像までのように、順次フレーム数が増加する場合もある。なお、前者の一定フレ

ーム数の場合でも、符号化したフレーム数が定めた一定期間を満たさない場合は後者と同様に順次フレーム数が増加していくことになる。

【００３６】これから符号化する現在の画像の画面複雑度Xk-c（k＝ i, p, b）は、現在の画像のアクティビティをACTk（k＝ i, p, b)、直前に符号化した同じピクチャタイプの画像の画面複雑度 Xk-p（k＝ i, p, b)、アクティビティACTk-p（k＝ i,p, b)より下記の式(2)で推定出来る。

【００３７】

$$Xk\text{-}c = Xk\text{-}p \cdot ACTk / ACTk\text{-}p \quad (2)$$

【００３８】なお、初期状態において、同じピクチャタイプの符号化の終了したフレームが存在しない場合は予めいくつかの画像で各ピクチャタイプの画像の画面複雑度とアクティビティを求めておき、それを平均的な動画像の発生頻度に合わせて統計的に平均してそれを初期値とすればよい。

【００３９】各ピクチャタイプの平均画面複雑度 Xi-ave, Xp-ave, Xb-aveと、これから符号化する現在の画像の推定画面複雑度 Xi-c, Xp-c, Xb-c はVBR符号量制御器５１に送られ、ここで可変ビットレート制御のための量子化スケールの設定が行われる。目標平均ビットレートをBitRate、１秒当りのフレーム数をPictureRate、１つの符号化単位である1GOP(通常はIピクチャの間隔)のフレーム数をNとすると、1GOPの平均割当符号量Raveは次式(3)で与えられる。

【００４０】

$$Rave = (BitRate / PictureRate) \cdot N \quad (3)$$

【００４１】上式のRaveは平均画面複雑度の時の1GOPの必要割当符号量とすると、これから符号化する現在の画像を含む1GOPの画像が一様に前記画面複雑度算出器２４で求めた現在の画像の推定画面複雑度に等しいと仮定すると、画質を一定に保持す場合に必要な1GOPの必要割当符号量Rck（k＝ i, p, b）は次式(4)で与えられる。

【００４２】

$$Rck = Rave \cdot Xk\text{-}c / Xk\text{-}ave \quad (4)$$

【００４３】上式のRck（k＝ i, p, b)を1GOPの各ピクチャに適切に割り振ることにより、これから符号化する現在の画像の第１の符号量制御手段における目標符号量を算出する。例としてMPEG2 Test Model 5の目標符号量割当方法を以下に挙げるが、これ以外の方法を用いてもよい。

【００４４】1GOPに含まれるP、Bピクチャのフレーム数をNp、Nb、Ｉピクチャに対するＰ、Ｂピクチャの量子化スケールの設定比率をKp、Kbとする。この時、各ピクチャタイプの目標割当符号量Ti, Tp, Tbは次式(5)(6)(7)で与えられる。なお、MAX[a, b]はａとｂのいずれか大きい方を選択する動作を示す。また、Xi, Xp, Xbはここでは直前に符号化したピクチャの画面複雑度(当該ピクチャの平均量子化スケールと発生符号量の積)である。

【００４５】

（Ｉピクチャ）

$$Ti = MAX[\,A\,,\,B\,]$$
$$A = Rc / (\,1 + Np \cdot Xp/(Xi \cdot Kp) + Nb \cdot Xb/(Xi \cdot Kb)\,)$$
$$B = BitRate / (8 \cdot PictureRate) \quad (5)$$

【００４６】

（Ｐピクチャ）

$$Tp = MAX[\,C\,,D\,]$$
$$C = Rc / (\,Np + Nb \cdot Kp \cdot Xb / (Kb \cdot Xp)\,)$$
$$D = BitRate / (8 \cdot PictureRate) \quad (6)$$

【００４７】

（Ｂピクチャ）

$$Tb = MAX[\,E\,,\,F\,]$$
$$E = Rc / (\,Np + Np \cdot Kb \cdot Xp/(Kp \cdot Kb)\,)$$
$$F = BitRate / (8 \cdot PictureRate) \quad (7)$$

【００４８】一方、CBR符号量制御器５２ではフレーム単位の平均量子化スケール、発生符号量が入力され、両者の積から直前に符号化したピクチャの画面複雑度Xi, Xp, Xbを求めて、BitRateが最高転送レート(BitRateMax)

の時の各ピクチャタイプの目標割当符号量Ti-max, Tp-max, Tb-maxを第１の符号量制御手段における目標割当符号量Ti, Tp, Tbと同様に求める。ここで、1GOPの平均割当符号量Rav-maxは各ピクチャ共通で、次式(8)で与えられる。

【００４９】

$$Rav\text{-}max = (BitRateMax / PictureRate) \cdot N \quad (8)$$

よって、

【００５０】

（Ｉピクチャ）

$$Ti\text{-}max = MAX[A, B] \quad (9)$$

$$A = Rav\text{-}max / (1 + Np \cdot Xp/(Xi \cdot Kp) + Nb \cdot Xb/(Xi \cdot Kb))$$

$$B = BitRateMax / (8 \cdot PictureRate)$$

【００５１】

（Ｐピクチャ）

$$Tp\text{-}max = MAX[C, D] \quad (10)$$

$$C = Rav\text{-}max / (Np + Nb \cdot Kp \cdot Xb / (Kb \cdot Xp))$$

$$D = BitRateMax / (8 \cdot PictureRate)$$

【００５２】

（Ｂピクチャ）

$$Tb\text{-}max = MAX[E, F] \quad (11)$$

$$E = Rav\text{-}max / (Np + Np \cdot Kb \cdot Xp/(Kp \cdot Kb))$$

$$F = BitRateMax / (8 \cdot PictureRate)$$

【００５３】上式のTi-max, Tp-max, Tb-maxは、すなわち、第２の符号量制御手段における目標割当符号量の上限であり、これらの値はVBR符号量制御器５１に送られて、前記した符号化する現在の画像の当該ピクチャタイプについて、前記したTi, Tp, Tbの値はTi-max, Tp-max, Tb-maxの値でリミッタがかけられ、現在の画像の目標割当符号量が決定する。

【００５４】上のようにして決定した目標割当符号量と、バッファ１６で検出される各マクロブロックの発生符号量をもとに、MPEG2 Test Model 5の方法を用いて各マクロブロックの量子化スケールを決定する。

【００５５】なお、画像特性検出器２５からは符号量制御器５１へも各マクロブロックのアクティビティACTcurが送られ、MPEG2 Test Model 5におけるアクティビティに基づいて各マクロブロックの量子化スケールを変更する適応量子化制御に使用されるが、この適応量子化制御は行わなくてもよい。またこれとは全く異なる方法で各マクロブロックの量子化スケールを決定してもよい。

【００５６】符号量制御器５１から出力される各マクロブロックの量子化スケールが量子化器１３に送られ、現在の画像（ＤＣＴ後の分割された原画像または動き補償予測の誤差画像ブロック）がこの量子化スケールで量子化され、可変長符号化されてバッファ１６で調整された後に符号が出力される。

【００５７】マクロブロック毎の量子化スケール、バッファ１６で監視される発生符号量がそれぞれ、平均量子化スケール検出器２２、発生符号量検出器２３に送られ、次のピクチャの符号量制御に使用される。

【００５８】なお、上の説明では、CBR符号量制御器５２における1GOPの平均割当符号量Rav-maxを、単純に最高転送レート(BitRateMax)の時に1GOPに割当てられる符号量として計算していた。これに対して、これから符号化する現在の画像の推定画面複雑度Xk-c (k= i, p, b)を因数とする、図2 (a)のような所定の関数、例えば、現在の画像の推定画面複雑度Xk-cが増大するとその値が限りなく１に近付く関数ｆ(Xk-c)を設定する。

【００５９】ピクチャタイプ毎にこの関数を乗算した次式(12)のRav-max′をRav-maxの代りに使用することにより、図２(b)に示されるように、各ピクチャタイプの最高転送レートに近い場合の発生符号量を徐々に押さえると共に、最高転送レートを超えた点で画面複雑度と割当符号量の関係が不連続になることから生ずる、当該ピクチャタイプの画質劣化が顕著になる問題を押えることも可能となる。

【００６０】

$$Rav\text{-}max' = f(Xk\text{-}c) \cdot (BitRateMax / PictureRate) \cdot N \quad (12)$$

ここでｆ(Xk-c)は図２(a)に示す関数 (k=i, p, b)

【００６１】つぎに、本発明の動画像符号化装置の第２の実施例について、以下に図３と共に説明する。第２の

実施例では、２パス方式の可変ビットレート符号量制御に本発明を適用した場合である。原画像入力～可変長符号化器１５で符号に変換されるまでの基本的な符号化部分は第１の実施例と同一である。大きく異なるのは1つの画像について、符号化動作が２回(またはそれ以上)行われ、最初に仮符号化が行われ、その発生符号量の結果を基に２回目の符号化が行われるため、両者の符号化動作に異なる部分があることである。

【００６２】1回目の符号化では、量子化器１３に送られる量子化スケールはVBR符号量制御器５１から送られるのではなく、スイッチSW1を介して仮符号化量子化スケール設定器５６から一定の値(６とか８といった値)が送られ、これにより固定値の量子化が行われる。そして可変長符号化器１５において可変長符号化が行われた後のビットストリームはそれを外部に出力するためのバッファ１６に送られず、スイッチSW2を介して仮符号化発生符号量検出器５３に送られて、１回目の符号化における各画像の発生符号量が検出される。

【００６３】発生符号量は順次仮符号化発生符号量検出器５３から仮転送レートメモリ５４に送られ、所定期間毎に加算されて、仮転送レートが算出される。この操作が１つの画像シーケンスの符号化が終了するまで行われ、仮転送レートメモリ５４には所定期間毎の仮転送レートが蓄積される。

【００６４】１回目の符号化が終了すると、画像シーケンス全体の仮発生符号量または平均仮転送レートが算出され、この値と所定期間毎の仮転送レートが目標転送レート算出器５５に送られ、２回目の符号化(実符号化)における所定期間毎の目標転送レートが算出される。

【００６５】なお、１回目の符号化における所定期間毎の仮転送レートRtと２回目の符号化の目標転送レートRとの関係は、予め所定の関数を設定しておく。例えば次の(13)のような関数が考えられる。

【００６６】

$$R = a \cdot (Rt)^{b} \quad (a,\ bは定数,\ a>0,\ 0<b<1) \qquad (13)$$

【００６７】１回目の仮符号化が終了し、２回目の符号化の目標転送レートが決定するとその目標転送レートに従って２回目の符号化(実符号化)が開始される。２回目の符号化では、量子化器１３に送られる量子化スケールはVBR符号量制御器５１で得られた値が送られる。

【００６８】ここで、VBR符号量制御器５１では、平均量子化スケール検出器２２、発生符号量検出器２３で検出された各フレームの平均量子化スケール、発生符号量と、目標転送レート算出器５５で仮符号化結果から算出された所定期間毎の目標転送レートから、これから符号化する画像の目標割当符号量が求められる。

【００６９】一方、CBR符号量制御器５２で算出された(第２の符号量制御手段における)目標割当符号量の上限もVBR符号量制御器５１に入力され、前記目標割当符号量にリミッタがかけられ、目標割当符号量が決定する。CBR符号量制御器５２における目標割当符号量の上限は第1の実施例における（Rav-maxによる）Ti-max, Tp-max, Tb-maxと同一である。

【００７０】以上のようにして決定した目標割当符号量と、バッファ１６で検出される各マクロブロックの発生符号量をもとに、第１の実施例と同様にMPEG2 Test Model 5等の方法を用いて各マクロブロックの量子化スケールを決定する。

【００７１】このようにして決定された各マクロブロックの量子化スケールが量子化器１３に送られ、これから符号化する画像(ＤＣＴ後の分割された原画像または動き補償予測の誤差画像ブロック)がこの量子化スケールで量子化され、可変長符号化される。

【００７２】ここで発生するビットストリームは、２回目の符号化ではバッファ１６に供給され、ここで目標転送レート算出器５５で算出された所定期間毎の目標転送レートによって調整された後に符号が出力される。マクロブロック毎の量子化スケール、バッファ１６で監視される発生符号量がそれぞれ、平均量子化スケール検出器２２、発生符号量検出器２３に送られ、次のピクチャの符号量制御に使用される。

【００７３】更に、本発明の動画像符号化装置の第３の実施例について、以下に図４、図５と共に説明する。以上の第１及び第２の実施例は可変ビットレート符号量制御に本発明を適用した場合であるが、本発明はそれに限定されず、幅広い応用が可能である。図４に示される動画像符号化装置のように、バッファ１６の出力の符号化ビットストリームをストリーム分割器５９で２つに分ける。その一方の出力は図５のようなＩ，Ｐ，Ｂピクチャ全てを使用した符号化ビットストリーム全体を出力し、もう一方はそのうちＩとＰピクチャのみを使用した符号化ビットストリームを出力する。

【００７４】Ｉ，Ｐピクチャのみの出力は、ここでは図示していないヘッダ変換器で、ヘッダ部分のパラメータ等が適切な値に書き換えられているものとする。図4の符号量制御器１（５１Ａ）はビットストリーム全体の符号量を制御し、符号量制御器２（５２Ａ）はＩとＰピクチャのみのビットストリームの符号量を制御する。

【００７５】ここで、符号量制御器１（５１Ａ）と符号量制御器２（５２Ａ）で各ピクチャタイプの平均割当符号量が比較的近い値となるように、両者の平均ビットレートが設定されているものとする。２つのビットストリームの符号量制御を同時に満足するために、符号量制御器２（５２Ａ）におけるＩ，Ｐピクチャの符号量割当結果を符号量制御器１（５１Ａ）に送り、符号量制御器１

（５１Ａ）ではＩ，Ｐピクチャについては符号量制御器２（５２Ａ）の結果のＩ，Ｐピクチャの符号量割当をそのまま適用し、Ｂピクチャについては新たに符号量割当を行って、符号量制御器１（５１Ａ）の制御を実現する。

【００７６】これによりビットストリーム全体では符号量制御器１（５１Ａ）による制御が行われると同時に、ストリーム分割器５９でビットストリームのＩ，Ｐピクチャ部分を取り出した場合は符号量制御器２（５２Ａ）で制御されたビットストリームを得ることが出来る。

【００７７】なお、ストリーム分割器５９でＩとＰピクチャのみのビットストリームを出力する必要のない場合は、符号量制御器２（５２Ａ）による符号量割当は行わずに、符号量制御器１（５１Ａ）において、Ｉ、Ｐ、Ｂピクチャ各々について、通常の符号量割当を行う。符号量制御器２（５２Ａ）による符号量割当は行わない場合は、それを示す信号をストリーム分割器５９に送り、そこでＩとＰピクチャのみのビットストリームを出力を止める。

【００７８】図４の実施例に限らず、本発明は２つの符号量制御器を有する符号量制御形態において、主たる方の符号量制御器５１Ａに対して、従なる方の符号量制御器５２Ａの各ピクチャタイプ毎の符号量割当結果によって制限を加えることによって、各ピクチャタイプの符号量割当の適正化を図り、もしくは１つの符号化ビットストリームに対して２つの復号系に対応した、動画像符号化装置を実現することが出来る。

【００７９】

【発明の効果】以上のように本発明によると、符号化画像の割当符号量を決定する第１の符号量制御手段と、第１の符号量制御手段の符号量割当に制限を加える第２の符号量制御手段を有し、例えば可変ビットレート制御の場合、第１の符号量制御手段では可変ビットレート制御、第２の符号量制御手段では最高転送レートの固定ビットレート制御により割当符号量を求め、実際の割当符号量は、第１の符号量制御手段で得られる割当符号量が第２の符号量制御手段で得られる割当符号量を上回った場合のみ、第２の符号量制御手段で得られる割当符号量を適用し、それ以外の場合は第１の符号量制御手段で得られる割当符号量を適用する。これによって、目標平均ビットレートが最大転送レートに近い場合においても、Ｂピクチャに不必要に多くの符号量を与えることもなく、ピクチャタイプ間の符号量割当を最適に保持することが可能になる。

【００８０】また、１パス方式の可変ビットレート制御で、各画像の発生符号量と平均量子化スケールの積に所定の操作を施して得られる画面複雑度を用いた制御を行う場合、画面複雑度を因数とする所定の関数を設定し、この関数を前記の第２の符号量制御手段で得られる割当符号量の上限に乗じて割当符号量の上限を変更することにより、割当符号量の上限に近い部分における符号量の増大を抑制すると共に、割当符号量の上限を超えた点での画質変動を緩和することが可能になる。

【００８１】また、上記の動画像符号化装置を応用して、１つの符号化ビットストリームを２つの復号系で共用する場合においても、第２の符号量制御手段で得られる符号量割当によって第１の符号量制御手段の符号量割当を制限することにより、１つの符号化装置で２つの復号系において復号可能な符号化を行うことが可能となる。

【図面の簡単な説明】

【図１】本発明の動画像符号化装置及びその方法の第１の実施例を示したブロック構成図である。

【図２】本発明の第１の実施例の$Rav\text{-}max'$算出の際の関数及び$Xk\text{-}c$と割当符号量の関係を示した図である。

【図３】本発明の動画像符号化装置及びその方法の第２の実施例を示したブロック構成図である。

【図４】本発明の動画像符号化装置及びその方法の第３の実施例を示したブロック構成図である。

【図５】本発明の第３の実施例のストリーム分割手段によるビットストリーム分割の様子を示した図である。

【図６】符号化ピクチャ構造の一例を示した図である。

【図７】一般的な動画像符号化装置の一構成例を示した図である。

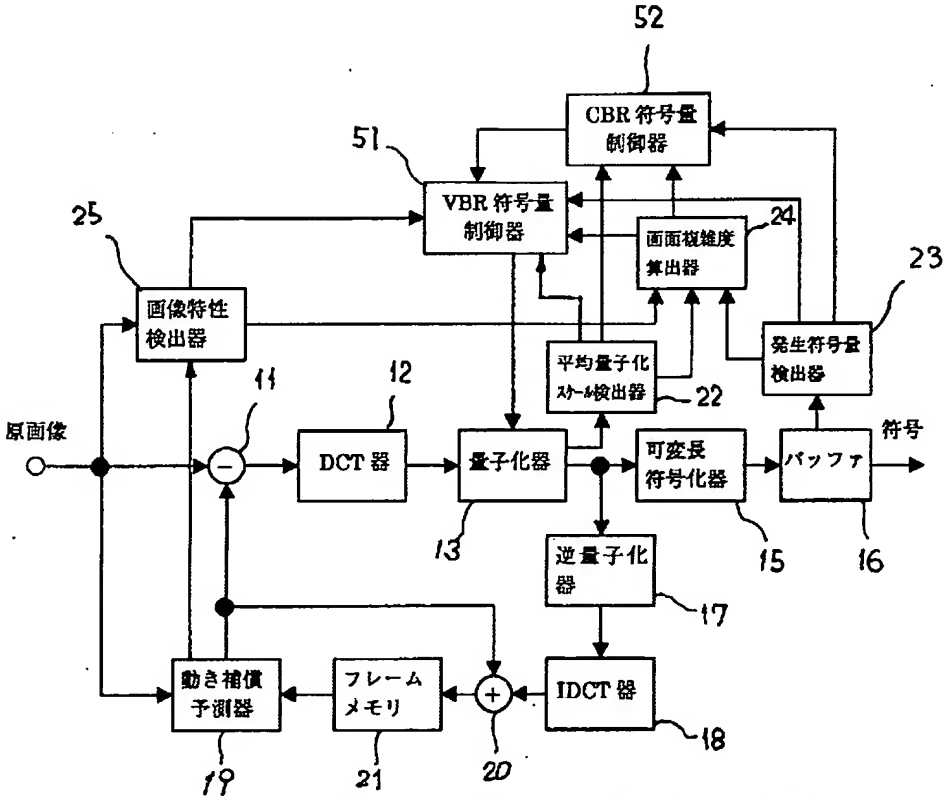
【図８】従来の動画像符号化装置の一構成例を示した図である。

【符号の説明】

１１　減算器
１２　ＤＣＴ器（直交変換器）
１３　量子化器
１４　符号量制御器
１５　可変長符号化器
１６　バッファ
１７　逆量子化器
１８　ＩＤＣＴ器
１９　動き補償予測器
２０　加算器
２１　フレームメモリ
２２　平均量子化スケール検出器
２３　発生符号量検出器
２４　画面複雑度算出器
２５　画像特性検出器
５１　ＶＢＲ符号量制御器
５２　ＣＢＲ符号量制御器
５１Ａ　符号量制御器１
５２Ａ　符号量制御器２
５３　仮符号化発生符号量検出器
５４　仮転送レートメモリ
５５　目標転送レート算出器
５６　仮符号化量子化スケール設定器

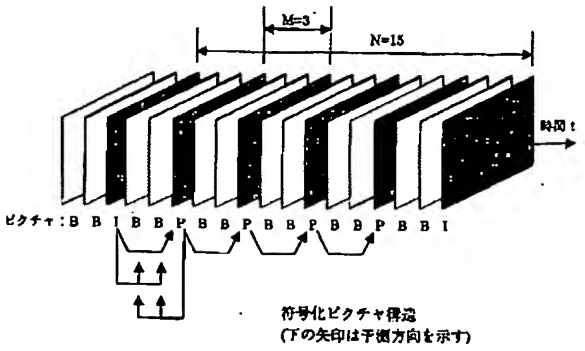
５９　ストリーム分割器
Rav-max　BitRateが最高転送レート(BitRateMax)の時の1GOPの平均割当符号量
Rck　1GOPの必要割当符号量(k＝ i, p, b)
SW1,SW2　スイッチ
Tk 各ピクチャタイプの目標割当符号量(k＝ i, p, b)
Tk-max　BitRateが最高転送レート(BitRateMax)の時の各ピクチャタイプの目標割当符号量(k＝ i, p, b)
Xk 現在の画像の画面複雑度(k＝ i, p, b)
Xk-c 現在の画像の推定画面複雑度(k＝ i, p, b)

【図１】



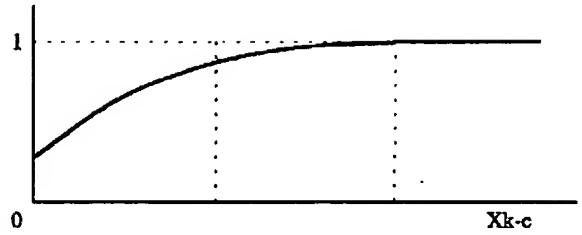
本発明の第１の実施の形態における動画像符号化装置

【図６】

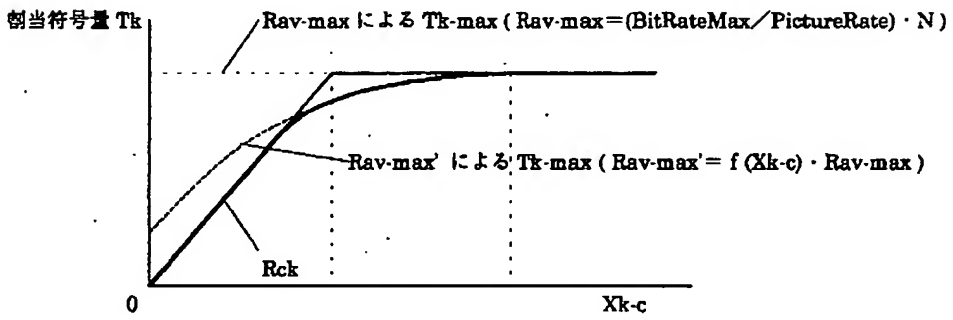


【図２】

(a) 関数　f (Xk-c)

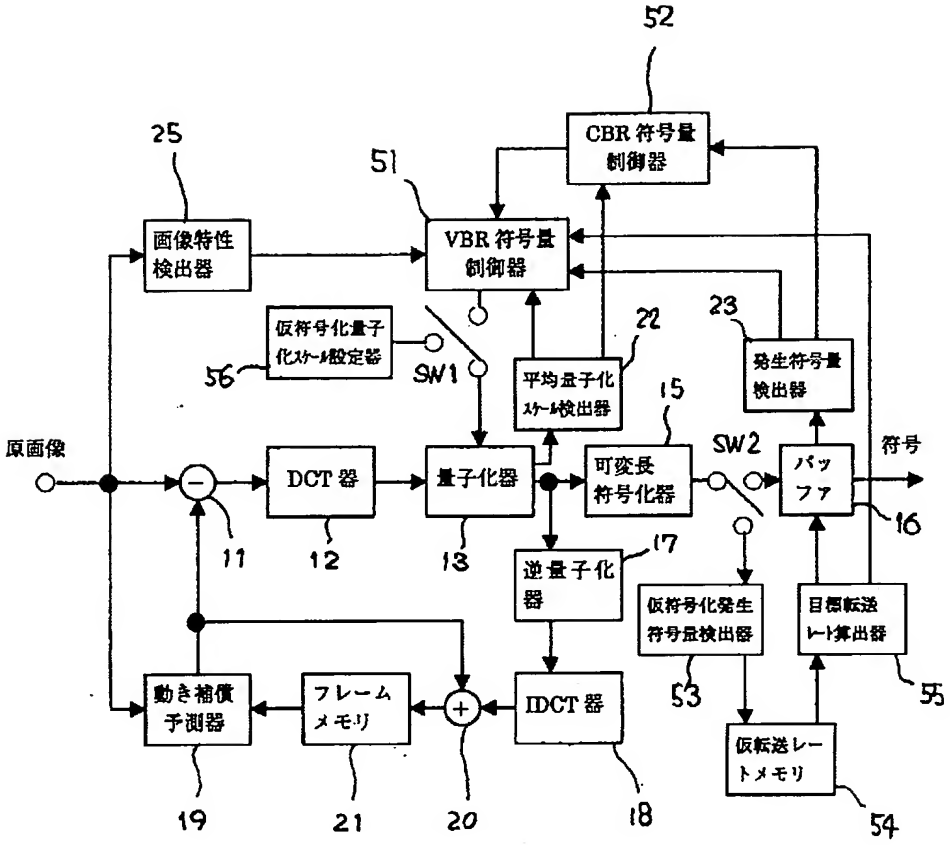


(b) Xk-c に対する割当符号量 Tk(k＝i, p, b)の関係



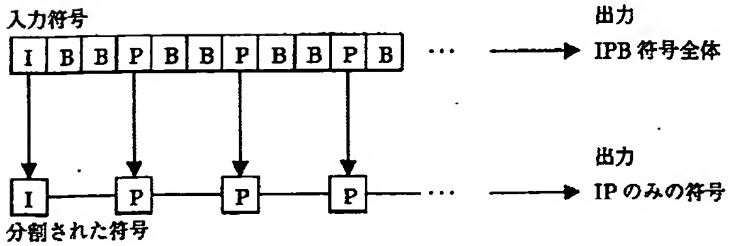
本発明の第１の実施の形態の別な例における Rav-max'算出の際の関数、及び Xk-c と割当符号量 Tk(k＝i, p, b)の関係の例

【図３】



本発明の第２の実施の形態における動画像符号化装置

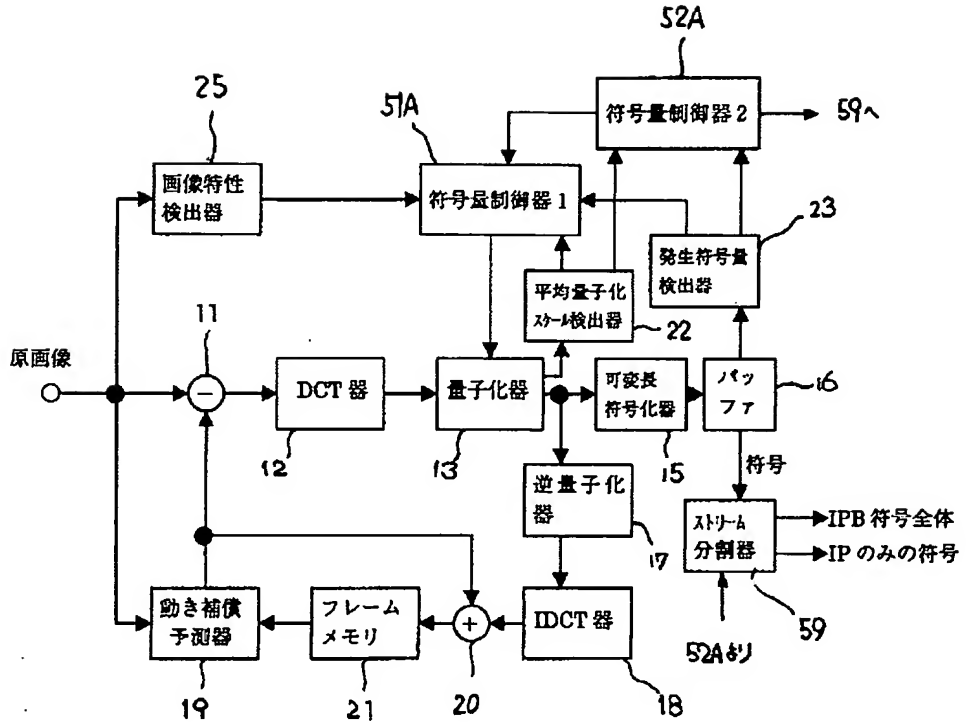
【図５】



(I：I ピクチャ、P：P ピクチャ、B：B ピクチャ)

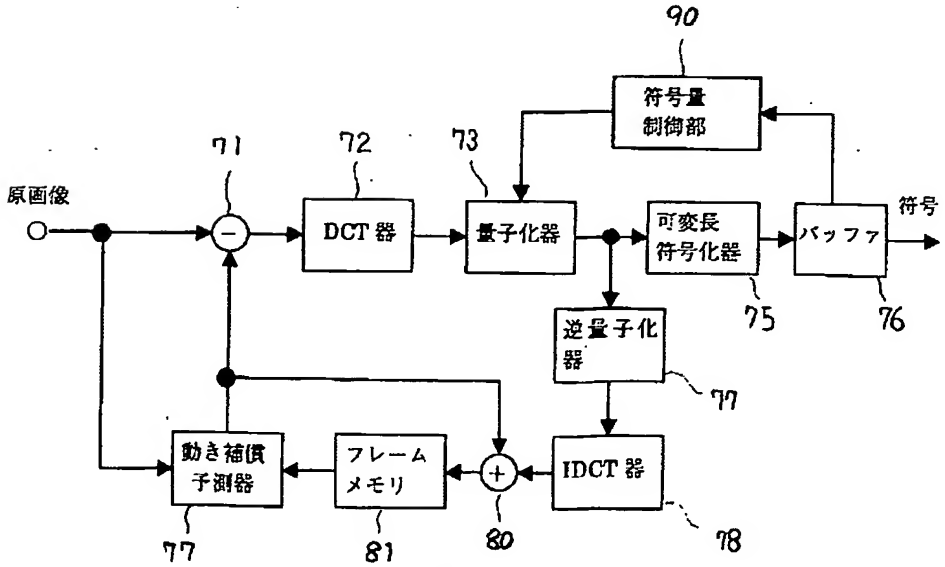
本発明の第３の実施の形態のストリーム分割器における
ビットストリーム分割の様子

【図４】



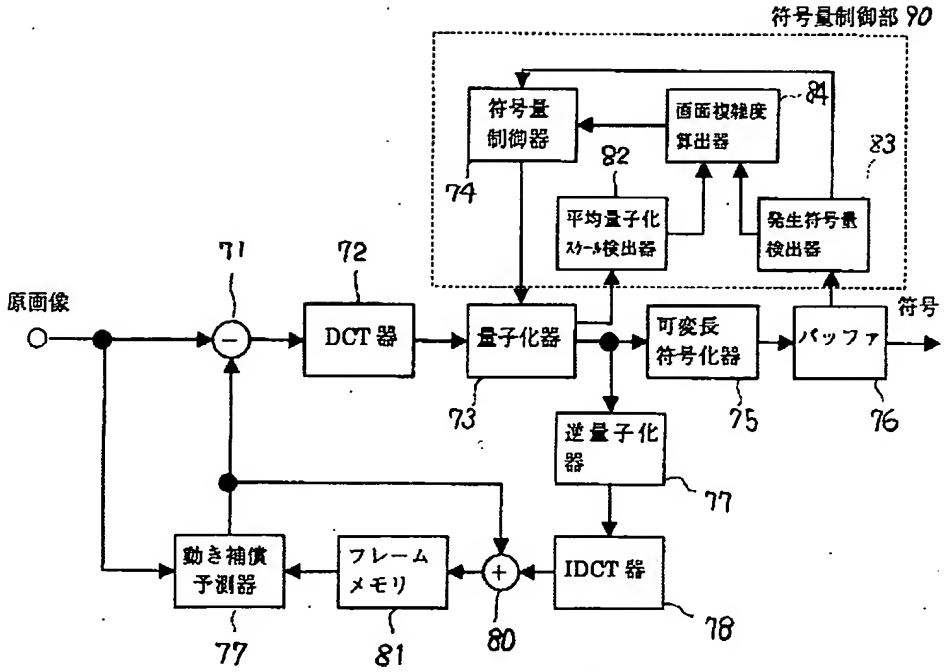
本発明の第３の実施の形態における動画像符号化装置

【図７】



一般的な動画像符号化装置の例

【図８】



従来例における動画像符号化装置

フロントページの続き

Ｆターム(参考)　5C059 KK01 KK22 MA00 MA23 MC11
MC38 ME01 NN01 NN28 PP05
PP06 PP07 SS11 TA60 TC02
TC10 TC18 UA02 UA33